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CHILD DEVELOPMENT

In this number there are reports of the development of perception and measurement of attitudes; of food consumption, attendance, colds, and sleep in nursery schools; of the form and function of children's questions; and of methods in child training.

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CHILD DEVELOPMENT

EDITOR-IN-CHIEF

BUFORD JOHNSON

Director of the Child Institute of the Psychological Laboratory, and Professor of Psychology of The Johns Hopkins University.

ASSOCIATE EDITORS

JOHN E. ANDERSON

Director of the Institute of Child Welfare and Professor of Psychology of The University of Minnesota.

E. V. McCOLLUM

Professor of Biochemistry, School of Hygiene and Public Health, The Johns Hopkins University.

EDWARDS A. PARK

Professor of Pediatrics, The Johns Hopkins University Medical School.

MANDEL SHERMAN

Director of Research, Washington Child Research Center, Washington, D. C.

T. WINGATE TODD

Professor of Anatomy, Western Reserve University Medical School

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CHILD DEVELOPMENT

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The Success of Young Children in Number and Letter Construction

GERTRUDE HILDRETH

TO TRACE the entire course of children's progress in learning to make numbers and letters would necessitate observation of the child from the time he makes his first random scribbles. For all practical purposes satisfactory data are obtainable from objective samplings of children's efforts to write taken at the age of four or five. The data represent an attempt to measure objectively the success of young children in their early efforts in making numbers and letters. Cumulative objective records of this kind are necessary for the determination of the nature of such learning and provide the only reliable basis for educational procedure with respect to it.

The ability to draw successfully from memory, or to copy letters or numbers depends upon maturity of two kinds, visual-perceptual capacity and motor coördination. Lack of adequate visual-perceptual maturity for copying designs successfully is illustrated in the case of the child who in attempting to copy the Diamond of the Binet test remarks during his struggles that he must "put the ears on." Suiting the action to the word, the resulting diamond, instead of having four straight sides, has several little excursions or projections that "spoil" his work according to the test standards. The child who has adequate visual-perceptive maturity for his task, but lacks sufficient motor control to execute it is illustrated in the not uncommon case of the child who can match designs or geometrical forms, but is unable because of inadequate motor control to produce more than a semblance of the original design which he is asked to copy.

DESCRIPTION OF THE TEST AND PROCEDURE

An objective test of six parts was constructed for the experiment. The materials were prepared in the form of a mimeographed booklet 6 by 8 inches in size, containing on the first page the following five geometrical forms to be copied:

This exercise was designed as a familiarizing and "warming up" device before the main part of the test was given. The results of the fore-exercise subsequently justified their inclusion in the tabulations of results. Page two consisted of blank squares containing identifying figures in each corner in which pupils were directed to write

the following numbers which the examiner dictated:

2 3 4 5 6 7 8 9 54 36 19 87 21

Children who experienced difficulty with this task were encouraged to do their best and to make an effort, even though they had never done anything of the kind before. Page three contained the following numbers opposite which ample space was provided for the child to copy the numbers:

6 3 9 5 7 8 4 2 15 43 109 276

On page four there were two columns of pictures of separate objects opposite which the child was directed to make a designated letter of the alphabet. Although the first letter of the name of each object corresponded with the letter to be written, this relationship was seldom pointed out except in the examination of older children who occasionally detected it themselves, for there was no necessity in the children's recognizing the relationship. The letters to be written were:

B R D E C M G K N P S H

The fifth page contained these letters arranged in two rows which the children were directed to copy. The last page contained a vertical row of the following words which the pupils were also directed to copy in the space adjacent to each word:

he at no dug bat was how

Since the children examined were wholly unable to spell, no attempt was made in this test to dictate the material before it was copied.

Four groups of children were given the test three times at intervals of approximately nine months. All of the children were attending the four or five year kindergarten groups or the first grade of the Lincoln School of Teachers College. At the time of the initial test the median ages of the four groups were respectively 4–5, 5–5, 6–5, and 6–6. Median intelligence quotients as established by the Binet Simon tests averaged 123, 126, 117, and 122, for the four groups. It may be objected that experimentation with such mentally superior subjects invalidates the findings for generalization concerning the progress of average children. Data for average children with the same material are lacking and until they are obtained the objection may be sustained. However, all children, bright, average or dull, start with zero ability in the present task and although the rate of progress may be faster in brighter subjects, the assumption may be made that all children pass through similar stages in acquiring mastery of number and letter construction, types of errors made are common and typical and almost complete perfection in the accomplishment is achieved in early school years, for the ability to make numbers and letters as a mechanical task has proved to be well within the capacity of all but the potentially feebleminded.

For the most part the test was given to pupils in their ordinary classroom groupings except in the case of the four year group who were taken aside in groups of three and four. Maximum effort was sought in order to get adequate information concerning types of errors made in early stages of learning.

Every effort was made to avoid giving the impression that the test was a teaching device or that the test represented good teaching practice. Progressive schools prefer to delay the teaching of writing until some significance can be attached by the child to the performance. In the present experiment this princple was purposely violated but with no ill-results to the children for the test was entered into in the spirit of a drawing game.

During the first period of the experiment there was no classroom instruction of four and five year old pupils in making numbers and letters. Only one of the first grade groups had writing instruction during the early course of the experiment, and this instruction was largely informal and based on pupil needs. During the second period of the experiment the first grade pupils had advanced to second grade where they were given practice in manuscript writing and in making numbers, but the five year group who had advanced to first grade were given only a limited amount of formal instruction. Just before the final test three pupils in one group were absent, but data for these three pupils were retained in the compuation of results for the first two tests. Reading instruction like handwriting was scarcely a factor in the early learning of the four and five year groups and one of the first grade groups. In the other first grade group reading instruction was begun informally but given regularly shortly after the school year was begun. The extent to which parental and home instruction accounts for success on the test is impossible to determine. Judging from remarks of parents and pupils, practically no children in the experimental groups had received regular or formal outside instruction. A parent's most frequent remark on hearing that the children had been given writing tests was to the effect that they had discouraged the children from writing, or that they had given instruction only when the children demanded it or showed unusual interest in it. A few parents were apologetic that they had neglected to give the children such instruction to prepare them for school work. Practice effect from the test was unquestionably present, but uniform throughout the experiment.

In scoring the papers one credit was allowed for each item correct, with a possible total score of 61 for a perfect paper. Uniform standards of scoring the construction of numbers and letters were adhered to in evaluating each item. Separate tabulations were made of the number of items correct, the number wrong, those partly right, items reversed and upside down, and items omitted. Items consisting of two or more digits or letters were scored solely for reversals, that is numbers of letters written inversely in a lateral direction or turned over. If the essential form of the number or letter was correct no deduction was made for accidental variations or irregularities due to poor motor control.

There are possibilities in the present data for answers to a number of interesting and important questions: What is the nature of the improvement curve? Of individual differences in accomplishing the same task for pupils of the same age or grade level? Which

items can be executed successfully at different age levels? To what extent do pupils make reversals in constructing number and letters in the early stages of learning? What is the quality of response at different ages as maturity increases? What is the nature and extent of other types of errors? What is the relation of handedness to the tendency to make reversals? What is the relation of success on the test to success in reading as measured by standardized tests? What is the relation between success in copying symbols and in attempting to make them from memory? Are sex differences in the present task discernible? Is there any relation between ability in number and letter construction and intelligence as measured by standardized tests? What is the consistency of errors on retests? What is the relation of school practice or training in the task and success in it as measured by the present test? Do any of the numbers or letters included in the test appear to be inherently more difficult to make than others? The data obtained during the experiment are sufficient to furnish at least partial answers to all the questions raised.

There are always chance errors to contend with in connection with any test and especially is this true in testing young children who are not always at the maximum of attention, and who are only with difficulty motivated to take tests. The broken crayon, the negavistic attitude, the tendency to ask for help and to expect it, disturbances of external and internal origin are sources of error affecting the data. The general tendency of such errors is to reduce maximum possibilities of accomplishment. In the main the testing conditions and the coöperation of the subjects were rated as excellent. Ideally perfect conditions are scarcely obtainable with pupils of this age.

RESULTS

Spearman makes the statement that all knowing comes from obscurity to clearness and that the process occupies a period of time. Nowhere is this principle better illustrated than in the present experiment. During the period between the ages of approximately four and seven the subjects of the experiment progressed from a stage of learning that was vague, confused, incoherent, to a stage of maximum clarity and ease of accomplishment. The excessive squirming and superfluous large muscle movements, the indecision, failure, enormous struggle and discouragement of the youngest pupils had disappeared at the time of the end test with the older pupils and had given place to orderly workmanship with ease of accomplishment in which superfluous movements had been reduced to a minimum, in which the child clearly showed in his total behavior his familiarity with the task, his success with it, and his delight in it. The difference between the children at the beginning and at the end of the learning period was so great as to constitute almost a complete transformation in attitude and capacity to achieve. The most frequent comment of the youngest children at the beginning of the experiment was "I can't do it. It's too hard. I don't know how. I've never done it;" of the older children "This is too easy—is this

all we have to do today?" The indecision of the younger children was shown in their hesitancy in proceeding with the task, in looking at the examiner for clues and suggestions, in actual requests for information as to how the symbols should be constructed. They very often made erasures, asked permission to do so or asked whether they should do so, and as often as not converted a correct item into an incorrect one. Children were frequently puzzled by the lateral direction of letters and numbers, and often asked, "Which way shall I make it?" On receiving no help they commented, "I'll just make it any old way," and in a great number of such

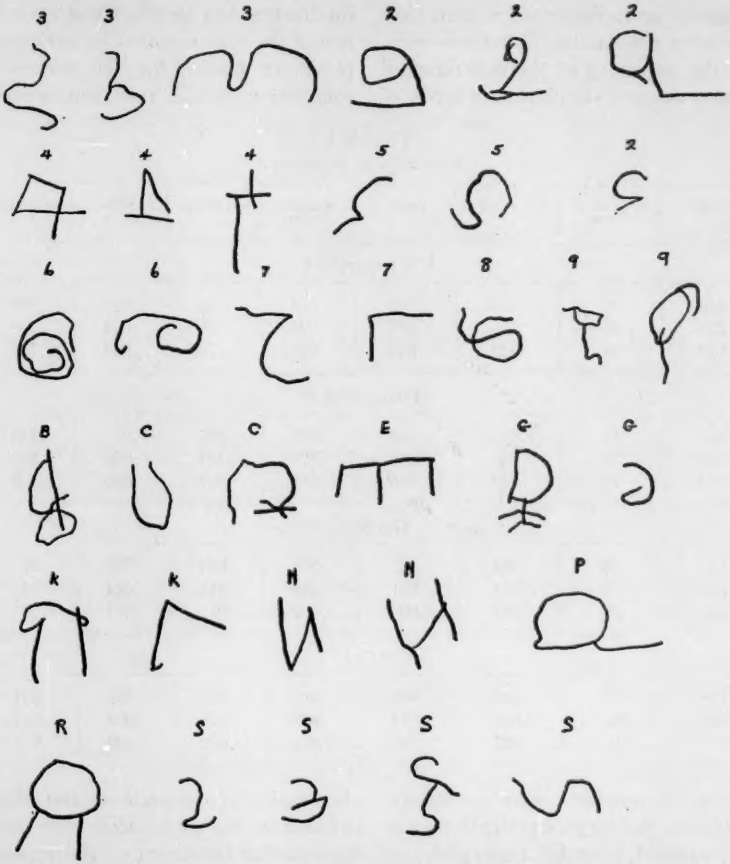

FIG. 1. ILLUSTRATIONS OF TYPICAL ERRORS MADE BY FIVE YEAR OLD PUPILS

instances a reversal of the symbol was made.

There was not only enormous improvement in attitude but in the quality of workmanship, which can scarcely be indicated in a statistical report of the number of items correct. At the beginning of the experimental period many of the children's copies of letters or numbers were extremely ridiculous, too large, too small, poorly proportioned, irregular, incomplete, or containing superfluous dots and dashes. Fig. 1 shows samples of typical errors made by five year old pupils. The material is not a facsimile reproduction of the pupils' writing but was traced in ink from the pupils' original work in crayon.

At the end of the learning period all was orderly and regular. In many cases the children's copies were fully equal in quality to the sample in the test paper. There was no time limit for the test and no effort was made to record the time required by individual pupils or classes for the successful completion of the test, but general observation of the younger and older children at work indicated very slow work at the beginning of the experiment and almost maximum speed with the older pupils.

TABLE 1

Percentage of responses

TEST	NUMBER OF CASES	CORRECT	WRONG	PARTLY RIGHT	REVERSALS	UPSIDE DOWN	OMITTED
Kindergarten 4							
1st	21	.235	.323	.076	.058	.028	.277
2nd	21	.56	.166	.022	.081	.013	.155
3rd	21	.743	.048	.028	.076	.004	.101
Kindergarten 5							
1st	16	.643	.037	.046	.037	.01	.164
2nd	16	.748	.039	.021	.134	.006	.049
3rd	16	.930	.005	.016	.045	.000	.003
Grade 1[1]							
1st	20	.804	.028	.025	.064	.003	.07
2nd	20	.875	.031	.012	.015	.004	.025
3rd	20	.967	.002	.002	.011	.001	.007
Grade 1[2]							
1st	21	.899	.007	.01	.056	.001	.024
2nd	21	.906	.014	.007	.055	.003	.014
3rd	18	.997	.001	.001	.001	.000	.000

Quantitative results

Table 1 indicates the percentage of responses that were correct, wrong, right, reversed, upside down and omit-

ted for all groups of children examined on the first, second and third tests. Fig. 2 shows in graphic form the percentage correct for all groups on all tests.

The results indicate continual and gradual rise from low to high percentages of items correct and simultaneously gradual decrease in items wrong, part right, upside down or omitted. Throughout the test, items scored as part right or upside down constitute a negligible proportion of the total number of items. Except for the four and five year kindergarten groups on the first test the number of omissions is also negligible.

FIG. 2. PERCENTAGE OF ITEMS CORRECT ON THREE SUCCESSIVE TESTS

Individual differences

Wide individual differences in score were present in all groups in all tests except the third series. The range and central tendencies of items correct for all groups is presented in table 2. In the case of grade 1² approximately all pupils made perfect scores with the result that individual differences practically disappeared. By the time this stage in the learning was reached practically all the pupils in the experimental groups had attained complete mastery of the skills to be performed. This period coincided with the end of the second grade. The range of individual differences becomes smaller from the first to the third test indicating that perfect achievement in the task set is being attained.

Differences were also apparent in the amount of gain in score of correct items. Gains were naturally largest between the first and second tests of

TABLE 2

	LOWEST	MEDIAN	HIGHEST
First test			
Kindergarten 4	1	10	39
Kindergarten 5	14	42	58
Grade 1¹	24	52	61
Grade 1²	43	56	61
Second test			
Kindergarten 4	5	39	51
Kindergarten 5	27	45	60
Grade 1¹	36	55	61
Grade 1²	45	57	61
Third test			
Kindergarten 4	10	48	59
Kindergarten 5	43	60	61
Grade 1¹	49	61	61
Grade 1²	60	61	61

the kindergarten group for most of the pupils of this group were in the beginning stages of learning. A tabulation of the gains for the 21 pupils of the kindergarten 4 group shows the following facts:

Points gained—first and second tests

LOWEST GAIN	MEDIAN GAIN	HIGHEST GAIN
4	21	41

Number and letter reversals

The tendency to make reversals, that is to invert the number or letter in a lateral direction, for example to make a "b" instead of a "d" was practically universal in the youngest groups of children. Instead of being a pathological sign as it is commonly supposed to be, it appears to be in younger pupils a definite stage in learning to make symbols correctly. The number of pupils in the present experiment who make one or more reversals on the first test is as follows:

Kg. 4..... 19 of 21
Kg. 5..... 14 of 16

Grade 1^1..... 17 of 20
Grade 1^2..... 16 of 21

The actual percentage of reversals made by the four groups of pupils in the three successive tests is shown in table 1. As might be expected reversals are much more prevalent in the younger groups and on the first test than in older groups and later tests. The results for the third test of the series indicates that by the time the pupils of groups 1^1 and 1^2 had reached the end of the second grade the tendency to make reversals had practically disappeared, although the tendency was quite prevalent at the time of the first test, and was especially so in the case of the four year pupils at the time of the first test. Observation of these children at work gave unmistakable evidence that the youngest children in the beginning stages of learning to make numbers and letters frequently have no clear notion of the direction in which the letter or number should be turned. In many cases it appeared to be purely a matter of chance whether a letter was turned to the right or to the left, and hesitation and great indecision marked the performance until the final choice of direction was made. There was also equal confusion as to which letter or number should come to the right or to the left in writing letters or numbers of two or more units. Although no separate tabulation of data was made on this point, this type of error appears to be as common and frequent as the case of reversing single letters or digits. In both the Kg. 4 and Kg. 5 groups there was a slight rise in the per cent of reversals from the first test to the second test and at the same time fewer omissions of items. On the other hand, the third test indicates in these two groups a decrease in the number of reversals made. These may be chance results due to the small number of cases involved, or they may actually be indicative of trends in learning. Younger children always made more attempt on second and third tests and it is reasonable to suppose that the increase in attempts would also result in an increase in different types of error. The children tended to make more reversals when

writing from memory than when copying, a result that was fully to be expected. Perception is more accurate when one has a sample of the symbol before him than when the memory solely must be relied upon. The elimination of reversals appears to be effected in part by maturation of perceptual powers and increased experience, familiarity, and by training in writing. In the 1^2 group there was one child who still persisted in making reversals on the third test, and in the 1^1 group, seven children who made from one to five reversals on the third test. There are occasional reports in psychological literature of persons who so consistently write in the wrong direction that they are termed "mirror writers." Of the pupils in the present experiment there were no individuals whose reversals were so consistent or so frequent as to constitute mirror writing. Of the reversals made there was not a high degree of consistency from one test to the next, nor in the children who made the reversals except in a very small number of cases. A child might make reversals on the first test and none nine months later on the second test, or he might reverse certain numbers or letters at the first test and reverse different ones at the time of the second test. As an illustration of the large amount of chance that enters into the child's choice of direction one's child's case is revealing. He said to the examiner when attempting to copy a figure three, "Please help me. Which way shall I turn it? I don't know—I'll turn it any way." The three was made reversed.

Reversals are by no means the only type of wrong letter construction although they constitute one of the commonest types of errors in the early stages of learning, possibly because the type of error is an easy one to fall into. Occasionally children made letters upside down or at an angle. The percentage of upside down scores is indicated in table 1. Considering the possible number of ways in which an "s" can be made even though the actual form of the letter is essentially correct

we gain some conception of the magnitude of the child's learning task in learning the right letter orientation. "S" and "n" are naturally the letters in which most difficulty occurs, and the errors seen most frequently on sign boards made by uneducated people, for in each case the bottom half of the letter is simply the reverse of the upper half.

Since younger children make reversals more frequently than older children and in the present experiment, at least, overcoming reversals was in large part due simply to gain in experience with age, in maturity of perception due to inner maturation, it would appear that some amount of reversal in number and letter construction is to be expected in early stages of learning, that in some cases the difficulty will be overcome without unusual training as the child matures, and that a rather definite level of maturity must be reached before the child can be expected to eliminate the tendency of making reversals. What this level of maturity is I should hesitate to state with so

limited a number of pupils of better than average maturity to start with.

A great deal has been written about the supposed interference with reading caused by a habit of making reversals. There is some slight evidence from the present data that ordinary instruction in reading and writing tends to correct a tendency toward reversals. This is naturally to be expected since reading and writing afford the child a chance to become more fully acquainted with the appearance of numbers and letters. There was also some indication that young pupils who had had least help from parents or teachers, who had been interested in making the symbols all by themselves showed the most tendency to make reversals. To such pupils the end result probably looked as satisfactory one way as another, and the child, since he learned nothing to the contrary, persisted in the habit.

Whether or not the habit of making number or letter reversals is a bad sign or is to be taken seriously depends probably more upon the age, experience and maturity of the child than upon any other factors. It is as these results indicate apparently a healthy and natural sign in the case of young bright children before school instruction has begun.

Handedness and reversals

The relation of handedness to the tendency to make reversals has never been completely established. Some authorities detect considerable relationship, others can detect none. A number of extreme cases of mirror writers have been discovered who are at the same time decidedly left handed, but whether these cases are the exception or the rule has never been determined. They may have come to the attention of research workers simply because the combined difficulties attracted unusual attention, or it may be that the two tendencies have an inner relationship and in consequence appear together in the same individual. Among the pupils of the present experiment the number of left handed children was too small to establish any rules or principles regarding the incidence of handedness and a tendency to make reversals. Such results as were found will, however, be cited. The data are limited to the first test but include all groups of pupils. Handedness was determined by observation of the children at work in using tools, pencils and in handling materials. Only those children were considered left-handed who invariably used the left hand in a wide variety of activities. Such a test is, of course, not a technical test of handedness but it constitutes a practical test that is adequate for the present purpose. A comparison is here given between left-handed pupils and those who were not left handed in the percentage of reversals made on the first test.

	NUMBER OF CASES	LEFT-HANDED PUPILS	TOTAL GROUP OMITTING LEFT-HANDED PUPILS
Kg. 4	2	.049	.059
Kg. 5	2	.18	.085
Gr. 1^1	3	.054	.066
Gr. 1^2	3	.08	.051

The differences are practically negligible but consistent from group to group. The cases are too few in number to establish the fact as a general principle. There were in the

experiment individual cases of right-handed pupils who tended more strongly than any of the left-handed pupils to make numbers and letters backwards, but since there are so many more right-handed pupils than left-handed pupils the comparison is scarcely fair for the larger the number of cases the greater the possibility for the appearance of exceptional cases of all kinds.

Relation between reading and writing instruction and success in making numbers and letters

Group 1^1 had received no formal school instruction in reading and writing up to the time of the second test whereas group 1^2 had from the beginning of the year instruction in reading and toward the middle of the year some instruction in handwriting the amount of which was increased toward the end of the year. In group 1^1 an activity program was substituted for the usual reading and writing instruction. It is therefore interesting to compare the two groups on the basis of success with the test in view of the marked differences in their school training.

	PER CENT CORRECT			GATES READING TEST (SCORES AT END OF SECOND TEST)
	Test one	Test two	Test three	
Group 1^1	.804	.875	.930	5
Group 1^2	.899	.906	.997	41

Rank correlation, reading and perception tests, .548.

The good showing of group 1^1 on test two which was given just before instruction of these pupils in reading and writing was begun indicates that the school training factor had little effect on the specific skills required for success in the perception test. The groups did almost equally well in spite of marked advantage of one group over the other in training in reading and writing skill. It may be assumed that the children's natural curiosity to learn coupled with natural maturity in perception and motor control enabled them to learn numbers and letters incidentally without formal instruction. Practice effect from the test may to a small degree have constituted training, but the time interval of nine months between tests precluded the possibility of much training from that source. The pupils of these two experimental groups had previously been roughly equated for another experiment on the basis of mental maturity, chronological age and kindergarten experience. The reading scores of the two groups indicate a substantial difference between the achievement of the two groups, but the difference between the two sets of perception scores is less significant. The children of group 1^1 show a high degree of success in making numbers and letters in spite of no formal school instruction in reading or writing. The slight difference in median I.Q. of the two groups, 117 for group 1^1 and 122 for group 1^2, may possibly account for all the difference found. The rank correlation of .548 indicates a fair amount of correlation between reading and perception scores.

Writing from memory versus copying

For the numbers 2, 3, 4, 5, 6, 7, 8, and 9, and the letters B, R, D, E, C, M, G, K, N, P, S, H, an opportunity was

given the child both to write the letters and numbers from memory and to copy them from samples provided on the test paper. The superiority of success when copying over writing from memory is shown in these results for the two groups on the second test:

	PER CENT MEMORY	PER CENT COPYING
Numbers		
Kg. 4	.226	.609
Kg. 5	.547	.928
Letters		
Kg. 4	.531	.791
Kg. 5	.551	.956

Letters are obviously more readily writen from memory than are numbers in the case of the Kg. 4 group.

Sex differences

The statement is frequently made that girls are more easy to instruct than boys in the early school years because of the fact that girls are more mature physiologically than boys at the age of five and six, more mature in muscular development, and consequently better able to do hand work skillfully and neatly. Since relatively fine motor coördination, ability to sit still and to pay attention are factors in successful achievement with the present tests we might expect the achievement of the girls to be higher than the achievement of the boys. The number of boys was practically identical with the number of girls in all but the five year group where there were six boys and ten girls. Pupils of groups 1^1 and 1^2 were treated as one group in studying sex differences in accomplishment. The results for boys and girls separately in terms of per cent correct are as follows:

	FIRST TEST				SECOND TEST			
	Number of cases		Per cent		Number of cases		Per cent	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Kg. 4...	11	10	.241	.242	11	10	.453	.68
Kg. 5...	6	10	.538	.706	6	10	.663	.734
Gr. 1...	20	21	.835	.869	20	20	.923	.896

Although there is consistently slight superiority of girls over boys the differences are too small to be considered significant and the number of cases is too small to admit of generalization.

Relation of success in the perception test to intelligence as measured by the Binet test

The results so far indicate that success with the perception test is a function of age. Correlation with intelligence or mental maturity is also a function of age and it is therefore logical to assume that there would be some correlation between intelligence test scores and perception test results. For the purpose of studying the relationship of the two sets of data two groups of pupils were selected on the basis of Binet I.Q. and chronological age. The age factor was kept constant by matching pupils for age. The two groups of pupils selected had I.Q.s above 125 or below 115 respectively, practically insuring a real difference between the two groups in

median I.Q. The resulting data are as follows:

	NUMBER OF CASES	MEDIAN I.Q.	MEDIAN AGE	PER CENT CORRECT		
				First test	Second test	Third test
More mature group	21	134	5–10	.723	.851	.951
Less mature group	21	108	6–0	.613	.756	.861

The differences found, though consistently in favor of the brighter group are not large. One reasonable explanation is that the perception test does not involve high level tasks. Complete success with the test is well within the capacity of the older but duller pupils. It was necessary in matching the two groups in chronological age to restrict the age range at the lower level because there were no mentally immature children in all the available data who were as young as the brightest pupils. This restriction in age necessarily limits the range of data.

Consistency of errors on retest

In order to determine the extent to which errors made on the first test were repeated on the second test the percentage of errors on the second test also made on the first test was computed. Results were obtained both for reversals and for all other types of errors combined.

	KG. 4	KG. 5
	per cent	*per cent*
Reversals	77	69
Others errors	60	68

In general, two-thirds of the errors made the first time were repeated on the second test.

Relative difficulty of different letters or numbers

The relative difficulty of different numbers and letters was determined by computing the degree of success the Kg. 4 and Kg. 5 groups experienced in making the symbols. In the Kg. 5 group most difficulty was experienced with numbers 5, 8, 2 and letters G, N, K, S. The easiest numbers were 3, 9, 7 and the easiest letters E, H, P. In the Kg. 5 group differences were neligible for no letters or numbers appeared to be easier or harder to construct than any others.

SUMMARY AND CONCLUSIONS

The results of a test of the ability of pupils in a four year kindergarten group, a five year kindergarten group and two first grade groups to make numbers and letters indicates gradual progress from a low to a high degree of success, for three repetitions of the test at nine month intervals. Types of responses scored include items correct, part right, reversed, upside down, items omitted and items wrong. Almost perfect scores were attained by the groups of pupils who had reached the end of the second grade at the time of the third test, indicating mastery of the skills involved in the test. Individual differences were present in all groups and for all three tests, though the differences were of a narrower range in the groups of older children at the time of the last test because of the fact that maximum achievement was prac-

tically reached by these pupils. The type of error termed a reversal, that is, the lateral inversion of a letter or number, appeared to be practically universal in the younger groups of pupils. These errors were gradually eliminated as results from the third test in the series indicate. There was apparently no relation between handedness and the tendency to make reversals in the small number of cases for whom data are available. There was only moderate correlation between reading test score and experimental test score and the experimental test score of pupils who had no reading or writing instruction up to the time of the second test was practically as high as that of pupils who had had reading or writing instruction, suggesting the independence of success with the test and reading instruction. Writing numbers and letters from memory proved to be a more difficult task for little children than making a copy of material given them. Sex differences were so slight as to be practically negligible, yet they were almost consistently in favor of the girls. Two groups of pupils matched for age but differing significantly in mental maturity differed in success with the experimental tests by small per cents and these differences were consistently in favor of the brighter group. A large amount of relationship is not to be expected since the material of the experimental test is of a comparatively low order of difficulty and perfect achievement is well within the capacities of the older and duller pupils. Comparing the errors made on a retest with errors made on the initial test, the amount of duplication of error on the second test is on the average about two-thirds the amount of error on the initial test. There was some evidence from a tabulation of correct responses for separate symbols, that certain letters and numbers are harder to make than others.

Implications for education: Large amounts of error are to be anticipated in the acquisition of skill in making numbers and letters on the part of young children. Individual differences are universal and should be detected as early as possible. Since reversals are practically universal in early stages of learning, they may be considered as rather logical errors in the learning progress of young bright children. One need scarcely anticipate that young bright left handed children are any more likely than right handed children to make reversals. Factors more important than handedness or school instruction appear to be informal opportunity to learn and inner maturation in perceptive and motor abilities. Knowledge such as that gained from the tests used for the present experiment should be available when formal instruction in handwriting is begun so that slower and faster learners may be given instruction appropriate for their needs. Practice can then be directed toward overcoming the specific errors the pupil consistently makes and can be placed on numbers and letters that experience shows are most difficult for pupils to make.

Theories and Measurement of Attitudes*

MANDEL SHERMAN

STUDIES of attitudes have been so numerous in the past ten years that the review of every article published in this field is hardly profitable because of the many repetitions and generalizations. As far as possible only those publications dealing with theories and experimental methods of measuring attitudes are reviewed. And because many writers have published the results of experiments both with adults and children some of the work on adults is also included. The publications cited are selected as being representative of the various students in this field. Additional references are given, part of which represent less definite studies and part of which repeat the statements of the authors cited.

Definitions in use by writers on the subject of attitudes have involved extensive controversy because nearly every experimenter has set up his own definition. An attempt to develop a concise definition of the term from the sociological standpoint was made by the Committee on Education for Citizenship, as quoted by Voelker (42):

"an attitude is properly settled behavior, a settled manner of acting because of habitual feeling or opinion. Three factors or aspects are here present, (I) an habitual mode of thinking, (II) a settled interest; (III) a settled mode of acting as growing out of habitual feeling or thinking. These three aspects give rise to three types of attitudes, according as one or the other element is emphasized: (I) a 'point of view' (apperceptive attitude); (II) an 'interest'; (III) an action attitude."

Faris (15) challenged the school of behaviorism for its attempt to limit behavior to observable movements, saying,

"The attitude is in part the residual effect of the act, but it remains as a predisposition to certain forms of subsequent activity. The motive or intention is an integral part of the act, and no estimate of the quality of the act can be made without considering the inner experience. . . . . Attitudes exist as tendencies to act; they are subjective, and therefore difficult to investigate; but many invisible objects can be studied, and a great many competent men are now engaged in research with every promise of notable success."

Other writers have used some such definition as "a set of mind which determines ones response to particular situations." To those who are accustomed to think of "mind-set" in philosophical terms this definition is quite acceptable because of its brevity and apparent familiarity. But for those who are accustomed to think of psychological phenomena in more

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scientific terms this definition is altogether too vague and philosophical. To many the term "mind-set" implies that the individual will react in a definite way under most conditions according to the attitudes he has developed. But most people realize that the behavior of an individual is entirely too variable, due perhaps to the variability of environment, to be measured in terms of attitudes, at best only a philosophical concept.

The definition of Chave (10) that an attitude is a complex of feelings, desires, fears, convictions, prejudices or other tendencies that have given a *set or readiness to act* to a person because of varied experiences, appears to be more concise and acceptable than most definitions used by sociologists until the statement is closely analyzed. For again, the term "set" is employed and the definition ends weakly with "because of varied experiences." The questions readily arise, What experiences? How do experiences develop attitudes? What are tendencies? When do tendencies materialize in behavior? Perhaps one should not be too critical because precise definitions of subject matter are extremely difficult to construct even in the exact sciences. The definition used by the group at Colgate University (3) is that an attitude is a general emotional and intellectual predisposition to act in a positive or negative direction as a result of personal experience and inborn tendencies. One wonders whether the authors have not attempted to be all-inclusive by trying to please everyone with the phrase "personal experience and inborn tendencies." Each writer in this field has struggled with the term, believing that only after defining the term is he able to go on with his experiments.

Faris (16), after discussing the quibbling that is current about the definition of the word, says, "But whether we speak of attitudes, of habits, or tendencies, or of dispositions is no great matter. In fact it is utterly irrelevant if so be that we are careful to know just what we are talking about." However, later in the same article Faris quotes Dewey (12) on the nature of an attitude, "an acquired predisposition to ways or modes of response, not to particular acts except as under special conditions, these express a way of behaving." This quotation by Faris containing the phrase, "acquired predisposition" is interesting when we refer to an article written by him in 1924 (14) in which he divides attitudes into several categories, the first of which is the two groups of hereditary and acquired attitudes. In his recent writing (16) much emphasis is placed by Faris on the fact that attitudes are not acts, they are predispositions, and therein lies one of the main problems in their study, ". . . . in strict phrase, an attitude, however real, must always be inferential." In the same volume Bernard (4) states that, "An attitude is an incompleted or suspended or inhibited act."

It is evident that unlimited time can be spent in listing the various definitions of the term attitude and the inconsistencies and differences in the statements of various workers. It is just possible that because attitudes have been studied in an experimental

way for only the past few years that the workers have not yet reached the stage at which they are more concerned with the experiments than with definitions of the term. We know, for example, that a large number of excellent studies have been made on intelligence but we still can be involved in controversies regarding its definition.

THEORIES OF THE MEASUREMENT OF ATTITUDES

Although attempts in objectifying studies of attitudes have been made only in the past twenty or twenty-five years, the subject of character, which is closely allied with attitudes, has been studied for more than two thousand years. Records show that one of the earliest character analysts, a so-called employment consultant, Theophrastus of Eresos, lived between 372 and 288 B. C. Between that period and the modern period of psychology sporadic attempts have been made at the explanation of human behavior in terms of character development. The term attitude has been used indiscriminately in the past (as well as at present), for the most part in the attempt to explain the intangible and intricate responses of man.

The modern theories about attitudes and their measurement are confined in this review to the work which has been done since 1920. In the past two or three years the subject seems to have become more confused because of the variety of workers entering this field—from political economists to psychologists and psychiatrists.

In 1920 Rugg (34) incorporated his positive theories of the measurement of attitudes in a rating scale using the man-to-man-comparison method. However, at this time others were not as convinced as Rugg of the validity and feasibility of measuring attitudes. In the following year Rugg (35) published his definite theory that the rating of human character is practical if it is done under the following conditions: "First: If each final rating given a person is the average of *three independent* ratings, each one made on a scale as objectified as the man-to-man-comparison type of scale. Second: If the scales on which the ratings are made are comparable and equivalent, having been made in conferences under the instruction of one skilled in rating scale work. Third: If the three raters are so thoroughly acquainted with the person rated that they are competent to rate." In a publication the same year the Allports (1) seemed to agree with Rugg when they stated that, "A well controlled process of rating individuals by associates is probably an adequte means of obtaining an objective notion of a group of personalities with which the results of tests devised for this sort of measurement may be correlated." The phrase "objective notion" is indicative of the lack of confindence at that time. They stated that their work was "to be regarded as merely the beginning of the investigation of personality." Later Allport (2) stated that ranking was a more objective method than rating.

Rugg (35) gave much credit to the work of Elliott who made one of the first suggestions for a rating scale in 1910. Rugg was one of a group of trained school officials who tested this

scale but obtained no significant correlations. The value of Elliott's work was in stimulating the development of rating scales. The Elliott Scale as well as the Boyce Scale was soon discarded and the first real progress in this field was made by a class at the Carnegie Institute of Technology in 1917 in the development of the man-to-man-comparison scale. This scale was utilized by Rugg in constructing his rating scale in 1920. W. I. Thomas is also credited with stimulating an interest in the study of attitudes.

From this time on many studies were undertaken using both the self-rating scales and the rating by teachers, parents and friends. Some workers found a high degree of discrepancy between self-rating and rating by others. Knight and Franzen (28) pointed out that in self-rating it is the tendency of the subject to overrate himself. Hughes (24) criticised the rating schemes then in existence and stated that the first requirement for the validity of a rating scheme is met only in the degree to which the rating situations are similar to normal life situations. He was also one of the first to show that a rating scheme is valid only when the individual is "himself" at the time of rating. He stated that the validity of a rating can be checked when there is agreement between the actual reactions of the individual and the results of the rating. This is precisely the difficulty which confronts many workers at present. Many theoretical traits are constructed on which the examinee is to be rated or rates himself with little relationship between his actual experiences and the questions asked. And few, if any, studies have been attempted to correlate the results of the rating with the actual behavior of the individual. Some students have pointed out that the difficulty of checking on the rating is too great and would require too much time.

In her comprehensive review and summary McDonough (29), in 1929, stated that the methods of studying character are as yet in the experimental stage and far from perfect. Watson (44) in 1925 pointed out that although the attitude of fair-mindedness could be measured there are many difficulties in accepting attitude measurement as valid. He appeared to be somewhat in doubt about the meaning of the results of his test. In many respects Weinland (46) was of the same opinion when he stated,

"In measuring attitudes however two differences from the intelligence testing program will have to be noted. First, since it complicates matters exceedingly to designate right attitudes and wrong attitudes while it may be perfectly possible to measure different attitudes, the norms will not be based on the number that answer right or wrong. The norm will be merely the average response to a given situation. . . . . One choice will, of course, not evince an attitude, but fifty choices or one hundred may, particularly when the choices of different people are contrasted according to some principle, such as sex, group uniformity, and so on. And when the situations to which choices are asked have been experimentally selected for their diagnostic value definite results can be obtained. And second, ... the norms should probably be established for different groups such as college students, doctors, lawyers, salesmen, and so on, rather than for different age levels or ability levels."

Not until very recently has a positive feeling regarding the feasibility of measuring attitudes seemed to per-

meate the literature. Nevertheless, those who believe that we have finally reached a stage of precision in measuring attitude are entirely too optimistic in view of the results of experimental studies. Olson and Jones (32) seem to have been too optimistic when they stated that, "Attitudes can no longer be considered to be unmeasurable. The work of Thurston, Watson, Chave, Droba, Hart, Jones, and others have indicated that it is feasible to measure attitudes reliably in cases where the subjects are sufficiently coöperative to answer truthfully various questions which are put to them." First, there is no reason to believe that attitudes have been measured reliability as yet. And second, when these authors state that attitudes can be measured in cases where the subjects are sufficiently coöperative to answer truthfully, the question naturally arises whether the measurement of attitudes does not include the method of making the subject respond coöperatively and truthfully. Indeed, the problem of the subjects' coöperation and truthfulness has complicated the entire field of psychiatry whether in studies of attitudes, emotions or personality. If we are sure the subject is coöperative and truthful we hardly need the many intricate tests in existence at present.

It is evident that sufficient experimental studies have not been made and that many investigators are still concerned with controversies regarding the definitions and theories of the measurement of attitudes. There is also great discrepancy in the use of the term "objective." Some writers believe that if their tests can be repeated on the same subject with similar results that their method is highly objective. Others point out that a so-called objective test may be highly subjective on both the initial examination and on its repetition.

METHODS AND RESULTS

In 1924 Starbuck (38) sent out a questionnaire in an attempt to learn the prevailing interest in the study of character and personality and the current theories. From the replies he received and the bibliographies on the subject, he stated,

> "it appears that there are at least one hundred and fifty professional psychologists and other educators working at the problem by methods that approach scientific refinement. The prevailing attitude is clearly one of confidence that we shall be able to analyze out the elements of character, define its types, and discover the limits within which it is possible to cultivate it. Only four persons among my respondents expressed doubts concerning the present and future of character tests and measurements."

He also stated that the following methods of approach were being used:

> "Direct observation of individual cases. Psycho-analysis. Association tests. Genetic and developmental studies. Self-analysis and self-measurement. Other rating by scale. Objective methods. Reference-judgments. Expressional reactions, other than judgmental. Experimental methods. A study of character types by all methods hitherto described."

The description of the different methods in use in the measurement of attitudes is difficult because in many cases there is no clear-cut separation of the technics employed. The methods can be divided in a rather loose and descriptive way into: rating scales, questionnaires and tests, and mechanically-objective measurements.

Three types of rating scales generally have been employed: self-rating, rating by others, and ranking.

Self-rating:

1. The subject makes an absolute judgment of the presence or absence of the given traits in himself.

2. The subject checks the point on a numerically arranged scale which he believes represents the degree in which the trait is present in himself.

3. In the use of paired adjectives, one desirable, the other undesirable, the subject checks the one which he believes applies to himself.

4. In the man-to-man-comparison, the subject compares himself with the "scale men" (previously selected by the experimenter).

Rating by others necessarily involves those who know the subject, or subjects, well, including teachers, parents, friends, and acquaintances, and follows the same scheme as in the self-rating method.

Ranking may be done either by the examinee or by others:

1. In self-ranking the examinee shifts any given number of words and phrases written on separate slips of paper into the order of merit he believes they represent in the living of life.

2. In ranking by others, the observers rank the persons by arranging them on a sliding scale from the highest to the lowest according to the degree in which they possess the given traits. Many workers have considered this method more objective than the rating scales previously described.

The most commonly used method of measuring attitudes has been by questionnaires and tests, which involve the answering of questions, either orally or in writing, by the subject himself or by others about the subject. The replies are analyzed for their diagnostic value. The most generally used forms of questionnaires involve:

1. Crossing out of words which are distasteful or which are considered irrelevant.

2. Word association. Upon hearing the stimulus word the subject immediately responds with the first word which occurs to him.

3. Series of questions to be answered:

a. By yes or no, or true or false. Some investigators have carried this method further by requiring the subject to go back over the questions after having answered them all by either yes or no, or true or false, and to underline the answers to the ten questions on which he feels strongly, then perhaps to double underline the five on which he feels most strongly of all.

b. By written answers which may involve only brief replies but may also involve lengthy ones concerning perhaps the solution of social problems, etc.

4. Series of situations are described involving choice, following each one of which are three or more solutions or responses from which the subject selects the one he would use.

5. Statements of fact are given, each followed by several conclusions. The subject is to check only those conclusions which are established by the facts given in the statement itself.

Many so-called tests are similar to forms described under questionnaires, but the following methods distinguish

them as tests rather than questionnaires:

1. Series of pictures to which the emotional responses of the subject are recorded.

2. Series of photographs or pictures for the subject to identify.

3. Series of problems to be solved, either mathematical or pictorial completion.

The phrase "mechanically-objective" has been used to identify the third group in the classification of methods in order to distinguish it from the many other so-called objective measures which utilize voluntary responses from the individual as the basis of measurement. In this group the involuntary responses are measured. A description of the method is given subsequently.

A study on self-rating was published by Washburn and Stepanova (43) based on the earlier work of Hollingworth (23) whose study revealed a tendency of college students to overrate themselves on desirable traits. These two investigators made what they considered two improvements in Hollingworth's method. First, instead of comparing the members of a group among each other and arranging them in order of merit, thus using a relative standard, their observers made absolute judgments of the presence or absence of certain traits: and second, they used a set of traits in which the factor of complimentariness or uncomplimentariness was reduced to a minimum. The investigators suggest two important influences as affecting the relation between judgments of self and judgments of others on oneself. The first relates to whether the trait judged is one that is habitually repressed in society. People do not give free social expression to such traits but may be aware of them in themselves, so therefore rate themselves higher on them than do their friends. Second, traits which are socially desirable refer to an ideal standard which will be higher in proportion as a person's performance judged by others is more excellent. In other words, a really careful, industrious, orderly and punctual person is not satisfied with his own performance. Hence they interpreted their results as showing a tendency for a person to under-estimate his own possession of desirable traits when his own judgments are compared with those of his companions on himself. These results are at variance with the results of other studies which showed that individuals tend to over-rate themselves on desirable characteristics.

The study of Hurlock (25) showed a tendency for children to over-rate themselves on desirable personality traits. Of 12,690 responses made by the 423 children, only 763, or 6 per cent, related to socially undesirable character traits.

In general, the results have shown that rating by others is a more satisfactory method than self-rating. Moore and Gilliland (31) used the ratings of teachers and of close acquaintances on students' aggressiveness as the method of selecting the two groups used as subjects in their test of aggressiveness study. After using the method of rating by others in a study, the following conclusions were reached by Cleeton and Knight (11): "1. The ratings of close associates are

reliable. 2. The ratings of seventy casual observers are reliable. . . .4. The correlation between ratings of close associates and causal observers is slightly better than chance." May and Hartshorne (30), who have done extensive work in the measurement of character traits, have used this method of having teachers rate the children, and the pupils rate each other, in combination with other devices.

The most commonly used method of measuring attitudes, as mentioned previously, is that of tests and questionnaires. The popularity of this form of investigation is aptly described by Faris (16):

"The early reaction to the doctrine of attitudes obscured this fact (that attitudes, however real, must always be inferential) by assuming that attitudes are immediately revealed in the opinions and statement which are easily obtained by direct approach. And this inaugurated a questionnaire era of research on attitudes. Subjects checked off prepared statements, or filled in dotted lines, or responded to interviewers, the statement recorded being assumed to have immediate and unequivocal relation to the attitudes."

Droba (13) criticized the careless and unscientific preparation and organization of the majority of questionnaires. He objected to the method of using several forms of statements in the same test. He divided the types of statements in general use into three categories: the impersonal form, the personal form and the question form. He believes that the question form does not represent the opinion as well as the non-question form for the weight of the opinion lies in the response rather than in the question, while in the non-question form, the statement rather than the answer, is the opinion.

Thurstone (40) and Chave (10) attempted to objectify measurement scales. Through the application of statistical methods in the make-up of the tests and questionnaires they have attempted to eliminate some of the weaknesses of attitude measurement. The statistical work has confused many about the problem of attitudes. While it is admitted that statistical technics enable the examiner to scale the answers accurately, such work has proven very little about the validity of measuring attitudes. For the real question involved is whether the responses actually indicate a disposition to act in a given way rather than whether the answers can be scaled. The work of many in this field has shown that opinions are often obtained which are interpreted as steadfast attitudes but which actually have little or relatively little to do with the personality pattern of the individual. The statistical flare in scaling replies must be considered as a statistical technic and not as a method of measuring or validating attitudes. A somewhat analogous situation exists in the social intelligence tests where a given measure may be reliable statistically, but does not prove that social intelligence is being measured. It has been shown that most of the social intelligence tests are merely modified intelligence tests.

Many other forms of questionnaires and tests have been developed to measure given attitudes. Hart (21) published a study from the University of Iowa for which he developed an instrument for measuring the socializa-

tion of various groups of individuals by using tests containing words, phrases, and sentences to provoke contrasted sorts of reactions in persons having contrasted social attitudes and interests. Shuttleworth (37) adapted a form of the Hart test and used it to study attitudes toward money and wealth. Another well-constructed test was that of Watson (44) with which he measured fair-mindedness as contrasted with prejudice or bias upon certain religious and economic issues. A test was constructed by Travis (41) to diagnose character or personality through the use of fifty psychological and psychoanalytic terms selected as representing a number of mental-sets and personal attitudes. Symonds (39) arranged a questionnaire of one-hundred questions to study social attitudes as criteria of educational trends and a test of the objectivity of education.

Hartshorne and May (22) have used tests and questionnaires quite extensively in their work. One of their early publications was a report on their study of children's knowledge of right and wrong in which they utilized three tests. They used statistical methods in evaluating their results. Furfey's (18) objective test for measuring developmental age had a reliability of .76. It consisted of four parts concerned with play interests, reading interests, and attitudes to various ideals; and was validated against age and a rating scale. Other studies along this same line were done by Jones (26) (27) in the field of character guidance. He attempted to construct his test objectively and evaluated the results statistically. Weinland (46) attempted to develop an objective method of measurement of attitudes through the use of plus and minus signs in agreeing or disagreeing with fifty selected proverbs. Other representative investigators who have used the test and questionnaire method in their studies are: Filter (17), Ream (33), Burtt (7), Gates (19), Bird (5), Charters (9), Chambers (8), Gilliland and Burke (20), Wrenn (47), Weber (45), Shales (36), Bowden (6).

The phrase "mechanically-objective" is applied to the study of Olson and Jones (32), and because of the experimental nature of this work a brief summary of the method and conclusions are given.

A series of words and sentences bearing upon four controversial issues, religion, race, social relations, and economics and politics, was arranged for college students with a view to stimulating responses which would reveal emotionally toned attitudes toward these issues. The method used was an adaptation and extension of the Audrucksmethode employed by Luria in his investigation of criminals in Russia. The method consists of recording on a kymograph record the tremors and other responses of both hands preceding and accompanying the verbal responses to each of a series of words and sentences, which were called to the subjects in rapid-fire manner by the experimenter. The subjects were directed to give a verbal response to each word and sentence as promptly as possible and simultaneously to press down firmly with their fingers upon two rubber discs. The fingers were resting on these discs at all times, and therefore it was possible

to study the hand responses just preliminary to the main responses. These preliminary responses were supposedly significant. They appeared to record either amounts of tension prior to the main responses, or else the beginnings of responses which the subject endeavored to inhibit. Measurements were made of the heights of these preliminary runs on the kymograph records. A statistically reliable difference was obtained between the preliminary responses to the experimental (or controversial) and the control words and sentences.

Only small agreement was found between the test results and the judgments of fellow-students in ranking the subjects from the highest to the lowest as to the strength of their emotionally toned attitudes. It was the investigators' belief that while this low correlation was due in part to the errors of measurement in the test, it was also due in part to the unreliability of ratings.

It may be interesting to compare this work with the early study of Moore and Gilliland (31) on two conflicting points. One of the tests used by Moore and Gilliland was a word association test. In the first set-up of their apparatus a lip key as a recording device in circuit with a chronoscope was used. But the experimenters considered this unsatisfactory on account of the frequency with which the subjects tended to make lip movements, or even began to vocalize, before they were ready with the final response. These preliminary movements were considered as spoiling the record, and this method was discarded. As we have seen, Olson and Jones, considered these preliminary responses as significant and they form the important data of their study. The second conflicting point was the oral presentation of the stimulus words. Moore and Gilliland considered the oral presentation of the stimulus words unsatisfactory because of the possibility of slight misunderstandings, and the slight variations in emotional suggestion on the part of the experimenter. They therefore developed an apparatus like a motion picture screen on which the experimenter caused the words to appear at the desired intervals by means of a hand control. Olson and Jones, on the other hand, did not consider any variations in the voice or technic of the experimenter sufficiently important to substitute a more objective method for the oral presentation.

From the representative theories and methods cited in this review it is evident that relatively little progress has been made in the study of attitudes. One of the main difficulties has been in the assumption of the experimenters that the replies of the subjects indicated their true tendency to act in a given way. Those who criticize the present-day method of studying attitudes point out that what the examiner obtains is an opinion which in many cases is not the true opinion of the subject. Furthermore, the opinion of an individual often has relatively little relationship to his true attitude. And the questions or situations of the test may have little relationship to the actual experiences of the subjects. Few experimenters have taken into account the inhibitions that a person has in admitting his true

attitudes even to himself. This the psychoanalysts have pointed out in their studies of the distortion mechanism of dreams and phantasies.

From the literature it appears that the most reliable methods of studying attitudes thus far developed are those which take into account the possible inhibitions and distortions of the individual and in which the question or situation approximates the previous experiences.

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The Food Consumption of Nursery School Children*

MARY S. ROSE, ELDA ROBB AND GERTRUDE M. BORGESON

IT IS now over five years since the Child Development Institute of Teachers College organized its nursery school and initiated its nutrition service. During this time a consistent effort has been made to apply in the daily feeding of the children all that the modern science of nutrition has discovered regarding the best conditions for optimum health and normal growth. A nutritionist trained in nutrition, in child development and in education has not only been in charge of food preparation and service, but has been in daily contact with the mother or some other responsible guardian of each child in order to see that there was the best possible articulation between the home and the school, and has maintained close connections with the pediatrician, the nurse and the nursery school teachers.

In the nursery school the child's eating is very intimately bound up with the whole educational procedure. He enters at the age of eighteen months, perhaps. He is growing fast and must be fed in such a way as to promote development and avoid the evils of fatigue, indigestion, or malnutrition. Moreover, eating habits must be fostered which shall be desirable not only from psychological and social view points, but shall serve to lay the foundation for vigorous health in adult life as well as in the immediately succeeding years.

Articulation of the school program with the home program is necessary in order that the total food needs for the day shall be met every day. The meals must fulfill nutritive requirements, and must also be prepared and served in ways easy for little children to eat and digest, and in ways that foster desirable attitudes towards foods essential for healthy growth.

The nutritionist was always at hand when the children arrived in the morning, to learn about the child's breakfast and anything with regard to the time spent at home which might bear on the food situation. She generally saw the mother, too, upon her return for the child at the close of the school session, and took this opportunity to give the mother any information which might modify the home feeding program. In order to have more tangible assurance that each child was getting a well-ordered diet, a special quantitative dietary study for a four or five day period was made as soon after the beginning of each term as the children had become thoroughly

* From the Child Development Institute and the Nutrition Laboratory of Teachers College, Columbia University.

accustomed to the nursery school régime. Graduate students in nutrition from Teachers College assisted in the collection of the data and made careful studies of the individual dietaries in relation to each child's requirements.

Blanks were furnished for records at home and at school. Records of food eaten at home were kept by the mothers, after careful discussion of the precautions to be observed to insure accuracy. The following sheet of directions was given to each parent and explained in detail. It was also checked with the parent when completed, to avoid omissions or misunderstandings.

CHILD DEVELOPMENT INSTITUTE
514 West 126th Street
New York City

GENERAL DIRECTIONS FOR FILLING OUT DIETARY RECORD

Please read carefully before beginning the record

1. Measure the food in a measuring cup or spoon in order to be able to judge amounts.
2. Make all measurements level whether cup, tablespoon or teaspoon.
3. Give all recipes on the back of the sheet.
4. Write down only the amount of food that is actually eaten.
5. Make a note if more food is served than eaten.
6. Record everything eaten between meals.
7. Note kind of bread—whether white, whole wheat, or rye; and kind of cereal—oatmeal, wheatena, etc.
8. Note whether butter is used on bread and vegetables, and sugar on cereal, fruit, etc.
9. Record the approximate amount of water taken during the day.
10. Record time of serving each meal and the approximate time taken to eat it.
11. Fill out the record blank for each meal at the time when meal is eaten.

As the children came from American homes, superior intellectually and economically, and as the parents were as a rule most coöperative and painstaking, it is felt that their records have a high degree of reliability. In any case where there was doubt of such coöperation, the record has been excluded from the survey of the dietaries for the four year period which it is the purpose of this paper to report and discuss.

During the four years from the fall of 1926 to the spring of 1930, there were two nursery school groups, one for children under two and one-half years of age, the other for children over two and one-half and under four.

In classifying the 163 children whose dietaries are included in this study, all those from eighteen to thirty months of age have been put in the group designated as two-year-olds, and all those from thirty-one to forty-two months of age in the three-year-old group. The median age for the two-year-old group falls exactly at the twenty-fourth month, and for the three-year-old group at the thirty-seventh month.

The median height for the two-year-olds is 34 inches; for the three-year-olds, it is 37.5 inches. The median weights are 28 and 33 pounds respectively. These medians closely approximate those reported in the

Merrill-Palmer Standards of Physical Growth (11) and in Woodbury's Stature and Weights of Children Under Six Year of Age (13). One three-year-old child fell below the median height of the two-year-olds, and two of the two-year-olds were above the median height of the older group. Seven three-year-olds were below the median weight of the two-year-olds, and four of the younger group were above the median weight of the older group.

The children arrived at the nursery school between 8:30 and 9:00 in the morning and stayed until 3:00 in the afternoon. On arrival after inspection by the nurse, orange juice and cod liver oil were served. At present tomato juice is used instead and the cod liver oil is served separately after the noon meal, as the children became so attached to the orange juice-cod-liver-oil combination that they complained if their orange juice had no "bubbles." Dinner, the main meal of the day, was served at noon and milk and crackers at 2:30, before departure for home in the afternoon. The noon meal at school was planned to include:

Potatoes, practically every day.

At least one vegetable other than potatoes.

Eggs on at least 3 of the 5 days and liver once a week.

Toast made of 50 per cent whole wheat bread.

or

Sandwich made of 50 per cent whole wheat bread, containing small amounts of finely chopped raw vegetable.

Milk—6 to 8 oz. (14 to 16 oz. given during the day at nursery school).

Dessert—fruit alternating with milk-and-egg dessert.

The same menu was served to each group with some modifications in the methods of preparation due to the differences in age of the children. Vegetables were pureed for the younger group and chopped fine for the older. The younger group also received less raw vegetable and for dessert, fruit more finely cut. Individual adjustments were made mainly in the size of the servings given, changes depending on age, state of nutrition, food idiosyncrasies, marked dislikes, and physical condition.

Each Friday menus for the following week were distributed to the parents. In addition to the nursery school menus, suggestions were made for home breakfasts and suppers which would supplement the nursery school diet and make the day's plan complete. A sample menu for a week is shown.

In the period under consideration dietary studies were made of the diets of 58 children in the two-year-old group, 27 boys and 31 girls; and of 92 children in the three-year-old group, 45 boys and 47 girls. In dealing with the data, no separation of the sexes seemed advisable, considering the relatively small number of cases.

In a study of children's dietaries in institutions, it has been shown by Rose and Gray (5) that the distribution of the total calories among specified food groups is a practical way of determining the adequacy of the diet for children from 5 to 15 years of age, taking into consideration at the same time the total energy intake as

NURSERY SCHOOL MENU

MARCH 11–15, 1929

Suggested breakfasts and suppers

HOUR	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Breakfast 250–320 Cal.	Cereal ½–½ cup Milk 2 oz. Fruit 2–4 tbsp. Toast ½–1 slice Butter ½–1 tsp. Milk 6 oz.	Same	Same	Same	Same
9:15 70 Cal.	Orange juice 3 tbsp. Water 3 tbsp. Karo ¼ tbsp. Cod Liver Oil 1 tsp.	Same	Same	Same	Same
Dinner, 11:30 400–525 Cal.	Pea Puree with egg 3–5 tbsp. Mashed potato 3–5 tbsp. Toast ½ slice Butter 1 tsp. Milk ¾ cup Applesauce ¼–⅓ cup	Scalloped tomatoes 2–4 tbsp. Creamed liver 1–2 tbsp. Baked potato 1 Toast ½–1 slice Butter 1 tsp. Milk ¾ cup Fruit cup ¼–⅓ cup	String beans 2–4 tbsp. Scrambled egg 1 Potatoes 3–5 tbsp. Sandwich 1 slice Milk ¾ cup Butter 1 tsp. Orange Blanc Mange ¼–½ cup	Creamed carrots 3–5 tbsp. Potatoes 3–5 tbsp. Toast ½ slice Milk ¾ cup Butter 1 tsp. Tapioca ¼–⅓ cup	Spinach and egg 3–5 tbsp. Potatoes 3–5 tbsp. Sandwich 1 slice Milk ¾ cup Butter 1 tsp. Prune whip ¼–½ cup
2:30 95–175 Cal.	Milk 4–8 oz. Graham crackers 1–2	Same	Same	Same	Same
Supper 310–400 Cal.	Cream of tomato soup ¾–1 cup Croutons 1–2 slices Milk ¾ cup Baked banana 1	Oatmeal ½–½ cup Toast 1–2 slices Butter ½–1 tsp. Milk ¾ cup Junket ¼–½ cup	Milk toast 2 slices Sandwich ½–1 slice Milk ¾ cup Applesauce ¼–½ cup	Poached egg 1 Toast 1–2 slices Butter ½–1 tsp. Milk ¾ cup Fruit cup ¼–½ cup	Cream pea soup ¾–1 cup Toast 1–2 slices Butter ½ tsp. Milk ¾ cup Rice pudding ¼–½ cup

compared with estimated requirement, and the suitability of the daily program as shown by the menus. The main objective of the present study was a similar analysis of nursery school dietaries to see whether knowledge of the distribution of calories among six food groups as proposed by Rose and Gray would be helpful in evaluating the diets of these younger children.

The dietaries were accordingly analyzed for the per cent of total calories derived from each of the following six food groups:

I. Foods from Cereal Grains: Valuable primarily as a source of energy, but also contributing considerable protein, and, if whole grain products be used, capable of adding iron in readily available form, considerable vitamin B, phosphorus and other mineral elements.

II. Milk: The source of most of the calcium, much of the vitamin A and phosphorus, considerable of the vitamin B and vitamin G, as well as protein of the best quality and calories in a form easily taken.

III. Fruits and Vegetables: A well-chosen assortment should guarantee a liberal amount of vitamin C as well as other important contributions to the mineral and vitamin content of the diet.

IV. Fats and Oils: In little children's diets chiefly important as bearers of vitamin A, in form of cream, butter and cod liver oil. The fat in the composition of whole milk is counted as milk and not included in this group. The proportion of total calories from fat needs to be relatively low, lest digestion and appetite be impaired.

V. Sugars: In little children's diets sugar should be furnished chiefly in the form of lactose in the milk, which is not included in this group. Cane sugar, syrups, etc. should be used very sparingly, not to crowd out more important foods nor to disturb appetite and digestion.

VI. Eggs and Meat: For little children, it is important that calorie-bearing foods be chosen with regard to their specific growth-promoting properties. For this reason milk is given a high place in the allotment of total calories, and ordinary muscle meat, which is inferior in growth-promoting substances, is not allowed to displace more important foods. Instead, eggs, which are of great value for growth, being in this respect second only to milk, and liver which resembles eggs rather than muscle meats in its nutritive properties, are given first place in this group. With a liberal allowance of milk, this group must contribute a rather low proportion of the total calories, or the total protein intake may be disadvantageously high.

Since foods can be thus arranged in groups with fairly well-defined nutritive properties, it is possible to learn a great deal about the character of any diet by a study of the percentage of the total calories contributed by each group. For example, if the percentage of milk is low, calcium is almost certain to fall below the amount desirable for optimum storage, and phosphorus may also be too low. This method of study gives help in determining quickly which foods should be increased to improve the dietary and which can wisely be reduced in amount.

The total calories consumed by the two-year-olds ranged from 1000 to 1575 calories per day, the median for this group being 1275 calories, or from 35 to 55 calories per pound of body weight, with a median of 44 calories per pound. In analyzing the data, a frequency distribution was made for total calories per child per day using a step interval of 25 calories. For the three-year-olds, the range was from 950 to 1650 calories per day, the median being 1350 calories, or from 29* to 56 calories per pound, median 41 calories per pound.

In the Merrill-Palmer School (11) 33 children 30 months of age have been reported to have a median energy consumption of 47 calories per pound of body weight and 51 children 37 months old a median of 45 calories per pound.

In a study of 30 children from a children's orphanage and 25 from private homes, McKay (2) reports for 19 two-year-olds a food consumption of 41 calories per pound and for 18 three-year-olds, of 40 calories per pound. Winters (12) studied a group of 50 Texas children of nursery school age and found for two-year-old boys an average intake of 41 calories per pound, for two-year-old girls, 35 calories per pound. It would seem, therefore, that our children had a normal food consumption for their age, as compared with these other groups, and their height and weight records showed such progress as would indicate an adequate energy supply.

The distribution of calories among the six food groups mentioned above as compared with the proposed standards is shown in table 1.

The most conspicuous difference between the returns on this study and the standards to which they are referred, is the higher proportion of calories from the vegetable-fruit group. Among the families represented, the economic situation was not such as to demand a dietary of minimum cost. On the contrary the parents were willing to spend whatever might be necessary to give their children a

*One case, a very large child, 41.5 inches tall and 47.8 pounds body weight; no other child less than 32 calories per pound.

TABLE 1

Distribution of calories in percentage of total calories

FOOD GROUPS	TWO-YEAR-OLDS			THREE-YEAR-OLDS		
	Standard distribution	Nursery school		Standard distribution	Nursery school	
		Range	Median		Range	Median
	per cent	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*
Foods from cereal grains	18–20	8–33	20	20–22	12–38	20
Milk	55–65	36–59	49	50–55	30–57	46
Vegetables and fruits	10–12	10–31	20	12–14	9–30	20
Fats	3–4	2–16	5	4–5	2–15	6
Sugars	1–2	0–6	2	1–3	1–12	3
Eggs and meat	3–4	0–10	4	4–5	1–13	5

diet advantageous for growth. A number of the children were receiving vegetables for supper rather than the more inexpensive cereal foods and fruits were eaten frequently. The habit of eating vegetables and fruits is one to be encouraged, but care needs to be taken lest it be overdone in case of very young children. There must be constant watchfulness to be sure that they are maintaining excellent digestion, with normal stools, quiet sleep and no upsets.

With the higher proportion of vegetables and fruits there would necessarily be a lowering of some other food group. Very often the vegetabes and fruits replaced cereals. The percentage of total calories from milk was somewhat lower than the standard with which it has been compared, but the median consumption was from 30 to 31 ounces, or nearly a quart per child per day, and amounted to nearly half the total calories, being 48 per cent for the two-year-olds and 46 per cent for the three-year-olds. Five two-year-olds and 12 three-year-olds received less than 40 per cent of their calories from milk but in only three cases was this percentage under 35. Even with liberal intake of vegetables, a pint of milk a day does not supply calcium for optimum storage, as shown by Sherman and Hawley (7). Children with less than 40 per cent of their calories from milk had invariably less than the median calcium intake, though they did not always fall below 1 gram per day.

The fat is only one per cent higher on the average in each group than the maximum suggested in the standard, but in individual cases it rose surprisingly high. This was due chiefly to the cod liver oil taken, a number of children having had two teaspoonfuls daily prescribed for them by private physicians and a few as much as three teaspoonfuls. No rigid adherence to a stated figure is necessary but fat in cooking is best restricted to a minimum, lest appetite and digestion suffer. The tendency among the well-to-do is to use butter, cream, olive oil, and other fats more liberally than is best for easy, rapid digestion in little children, and computing the percentage of calories from fat serves as a check on an unduly high proportion.

In practically all cases the calories in the egg and meat group represent about one egg a day, plus occasional servings of liver and more infrequently a little white fish, such as halibut, or a small portion of crisp bacon. In case of ten children the average of calories from this group was from 9 to 13 per cent of the total calories. These were under care of pediatricians who insisted upon meat for the evening meal.

Sugar is desirable mainly for making palatable the fruits and other foods used for the children's very simple desserts. In a few cases the sugar rose to a proportion which must be regarded as very unsuitable for nursery school children, due to very generous use on the breakfast cereal.

To show what kind of dietary is represented by the median distribution of calories, shown in table 1, calories were allotted to each group on the basis of the median energy intake, as indicated in table 2.

The menu and dietary (see page 37) represent selection of foods for a die-

tary for a three-year-old child on the above basis. For the two-year-olds there would be slightly smaller amounts from each group except milk. For convenience the data have been calculated in shares, the values of which are as follows: protein, 2.5 grams; calcium, 0.023 gram; phosphorus, 0.044 gram; iron, 0.5 milligram.

The actual yield of the dietaries in protein, calcium, phosphorus and iron was estimated, although calculations based on average analyses and crude

TABLE 2

Distribution of calories on basis of median total energy intake

FOOD GROUPS	TWO-YEAR-OLDS		THREE-YEAR-OLDS	
	Per cent of total calories	Calories per day	Per cent of total calories	Calories per day
Foods from cereal grains	20	255	20	270
Milk	49	625	46	621
Fruits and vegetables	20	255	20	270
Fats	5	63	6	81
Sugar	2	25	3	40
Eggs and meat	4	51	5	67

measurements of food can at best be only rough approximations. On this basis, the protein intake of the children ranged from 0.9 to 2.4 grams per pound of body weight, the median for the two-year-old group being 1.6 and for the three-year-olds 1.5 grams per pound. The medians for the Merrill-Palmer Nursery School (11) group are the same, with a similar range, 0.83 to 2.69 grams. McKay (2) found an average intake of 1.3 and 1.2 grams per pound for the two and three-year-olds in her group. Roberts (4) found 31 physically superior preschool children all ingesting as much as 1.4 grams per pound of body weight. Winters (12) reports an average intake of 1.5 and 1.1 grams per pound for two-year-old boys and girls respectively, and 1.1 grams per pound for all of her three-year-olds. Since the main sources of protein in our children's dietaries are milk and eggs, insuring an amino acid assortment most advantageous for growth, and since Bartlett (1) has shown that children of these ages may be kept in positive nitrogen balance on from 0.6 to 0.9 grams of protein per pound of body weight, it is safe to say that a dietary with 46–48 per cent of its calories from milk will furnish a generous allowance of protein. Even for undernourished children, who may be able, as Wang (9) suggests, to use to advantage as much as 1.8 grams per pound, this standard will prove adequate if the total calorie intake is liberal.

The total calcium intake ranged from 0.78 to 1.5 grams per child per day, with median values of 1.13 and 1.17 grams per day for two and three year olds respectively. For optimum calcium storage Sherman and Hawley (7) recommend that one gram per day be furnished every child under fourteen years of age. They found that calcium

A DIETARY BASED ON MEDIAN CALORIE DISTRIBUTION

	Calories	*Calories*	*Per cent of total calories*
Milk—31 ounces		620	46
Cereals		270	20
Wheatena—½ cup	50		
Whole wheat bread (50 per cent) 4 slices	180		
Graham crackers—2 small	40		
Vegetables and fruits		275	20
Potato—1 medium	100		
Carrots—4 tbsp.	15		
Pea puree—4 tbsp.	35		
Orange juice—4 tbsp.	25		
Prune pulp—4 tbsp.	100		
Eggs and meat—1 egg		70	5
Fats		85	6
Butter—½ tbsp.	50		
Cod liver oil—1 tsp.	35		
Sugars		35	3
Sugar—1 tsp.	17		
Karo syrup—1 tsp.	18		
Total		1,355	100

FOOD	CALORIE SHARES	PROTEIN SHARES	CALCIUM SHARES	PHOSPHORUS SHARES	IRON SHARES
Milk	6.20	11.8	46.9	18.9	4.3
Wheatena	0.50	6.1	0.3	1.3	1.4
Whole wheat bread	1.80	2.8	2.0	2.8	2.2
Graham crackers	0.40	0.6	0.2	0.9	0.8
Potato	1.00	1.1	0.7	1.6	3.1
Carrots	0.15	0.1	0.8	0.3	0.4
Pea puree	0.35	1.0	0.4	1.0	1.2
Orange juice	0.25	0.1	0.7	0.2	0.2
Prune pulp	1.00	0.3	0.8	0.8	2.0
Egg	0.70	2.5	1.4	1.9	2.9
Butter	0.50				
Cod liver oil	0.35				
Sugar	0.17				
Karo	0.18				
Total shares	13.55	26.4	54.2	29.7	18.5
Total grams		66.0	1.2	1.3	0.009

MENU BASED ON PRECEDING PLAN

Breakfast

Orange juice	2 tbsp.
Wheatena	½ cup
Milk	8 oz. (for cereal and to drink)

Toast (whole wheat)	1 slice
Butter	½ tsp.
9:15	
Orange juice	2 tbsp.
Karo	1 tsp.
Cod liver oil	1 tsp.
Dinner	
Potato	1 medium
Carrots	4 tbsp.
Toast	1 slice
Butter	½ tsp.
Custard	¼ cup (4 oz. milk, ½ tsp. sugar, 1 egg)
Milk	5 oz.
2:30	
Milk	6 oz.
Graham crackers	2 crackers
Supper	
Cream of pea soup	½ cup (4 oz. milk, 2 oz. pea puree)
Bread	2 slices
Butter	½ tsp.
Milk	4 oz.
Prune pulp	4 tbsp. (½ tsp. sugar)

from milk is better utilized than calcium from vegetables. There were only 3 two-year-olds who fell more than 10 per cent below this standard. These were the ones whose milk intake fell below 45 per cent of their total calories, and whose total calorie intake per pound was below the median of the group.

The total phosphorus intake ranged from 0.84 to 1.54 grams per child per day, with median values of 1.14 and 1.18 for two and three-year-olds respectively. Inasmuch as calcium is stored in the body chiefly as calcium phosphate and low phosphorus values in the blood are unfavorable to calcium deposition, the intake of phosphorus must be optimal as well as that of calcium for the best bone and tooth development. Sherman and Hawley (7) have suggested that a dietary standard of 1 gram of phosphorus per day will best meet the needs of the growing child. There were none who fell as much as 10 per cent below this standard. Since milk in amounts adequate for calcium will also furnish most of the required phosphorus, this is what would be expected from the returns on calcium.

The total iron intake ranged from 5.5 to 12.0 milligrams per child per day, with median values of 7.5 and 8.5 milligrams for the two and three-year-olds respectively. A study by Rose, Vahlteich, Robb and Bloomfield (6) of the iron balance in a nursery school child aged two and one-half years, indicated that 0.75 mg. of iron per 100 calories of food ingested would be necessary to main-

tain a positive iron balance. The actual median values of our children's dietaries are about 20 and 25 per cent respectively above an intake of 0.5 mg. per 100 calories, due chiefly to the relatively liberal use of fruits and vegetables, and daily use of eggs. A seven-months study of the hemoglobin values of the blood of these children by Platt and Freeman (3) has shown for the most part good hemoglobin production, the values ranging from 9.8 (one case) to 16.6 grams of hemoglobin per 100 cc. blood and averaging 12.6. The average for this age as given by Williamson (10) is 12.9. Since the formation of hemoglobin is easily depressed in young children, and high iron reserves are undoubtedly desirable, it would seem that effort should be made to keep the iron intake of little children high. The use of vegetables to insure an adequate supply also of copper will aid in rapid hemoglobin building. It has been shown by Vahlteich (8) that whole wheat and oatmeal as supplements to milk are very efficient in promoting hemoglobin regeneration after experimentally induced nutritional anemia, hence the use of such cereal foods is a very convenient and economical way of fostering good hemoglobin production in young children. It is especially noteworthy, in this connection, that whole wheat and oatmeal were found to be more efficient in curing nutritional anemia than corresponding amounts of iron given in the form of lean beef or liver. The daily inclusion of a portion of whole wheat bread seems to be thus well supported.

Vitamins have not been calculated in detail owing to our still limited knowledge regarding the quantities in different foods, and our lack of any experimental work on minimum requirements in children.

The need for vitamin D we believe to be met in case of the healthy child by one teaspoonful of cod liver oil daily. This furnishes at least 45 to 50 units of vitamin D. In individual cases, physicians have prescribed more, as already noted. For cure of old rickets more is always needed than for prevention of their development in a healthy, well-fed child.

The value of vitamin C, not only as a protection against scurvy and a guarantee of good health and growth, but also as a very important factor in the development and maintenance of sound, hard teeth and healthy gums, has led to the daily administration at the nursery school of a portion of orange juice (3 tablespoons) so that no child might suffer from any serious shortage of vitamin C. Three tablespoons of orange juice or tomato juice (which is really not juice alone, but the whole tomato reduced to a puree) will furnish about 20 units of vitamin C. Other fruits and vegetables should make the allowance for the day at least twice as much.

Vitamin A, indispensable for normal health, growth and resistance to various prevalent micro-organisms, is furnished daily at the nursery school to the extent of about 1000 units in 16 ounces of milk and about 800 units in 1 teaspoonful of cod liver oil. In addition 1 teaspoon of butter will yield about 100 units, an egg yolk about 825 units, a half ounce of liver about 1400 units, ¼ cup of spinach about 2300 units. One vegetable being

served regularly in addition to potatoes, it is estimated that at the nursery school each child gets daily at least 3500 to 4500 units of vitamin A. With milk, butter, and vegetables also served at home, his chance of building many times the growth requirement seems to be desirable. The nursery school diet guarantees daily at least 200 units. Of these approximately 144 units are estimated to have come from 16 ounces of milk, 14 units from

TABLE 3

Summary of findings in dietary studies of 163 nursery school children

	TOTAL RANGE		25TH–75TH PERCENTILE		MEDIAN	
	2 year olds	3 year olds	2 year olds	3 year olds	2 year olds	3 year olds
Age, months	18–30	31 –42	21–27	34–39	24	37
Height, inches	31–39½	33½–43½	33–35	36–39	34	37½
Weight, pounds	22–35	26 –47	26–30	31–35	28	33
Total calories	1,000–1,575	950–1,650	1,150–1,325	1,250–1,450	1,275	1,350
Calories per lb	36–55	29–56	41–47	38–44	44	41
Calorie distribution in percentage of total calories:						
Cereals	8–33	12–38	16–24	17–23	20	19
Milk	36–59	30–57	42–53	43–49	48	46
Fruits and vegetables	10–31	9–30	16–21	16–22	18	19
Fats	2–16	2–15	4–7	5–8	5	6
Sugar	0–6	1–12	1–3	2–4	2	3
Eggs and meat	0–10	1–13	3–5	3–7	4	5
Total protein, grams	35–71	38–71	42–50	45–53	46	50
Protein per lb., grams	1.2–2.3	0.9–2.3	1.4–1.8	1.3–1.6	1.6	1.5
Total calcium, shares	38–64	34–65	45–54	48–56	49	51
Total calcium, grams	0.87–1.47	0.78–1.50	1.04–1.24	1.10–1.29	1.13	1.17
Total phosphorus, shares	20–33	19–35	24–28	25–30	26	27
Total phosphorus, grams	0.88–1.45	0.84–1.54	1.06–1.23	1.10–1.32	1.14	1.18
Total iron, shares	11–24	11–23	13–17	14–19	15	17
Total iron, grams	0.055–0.120	0.055–0.115	0.065–0.085	0.070–0.095	0.075	0.085

a reserve store of vitamin A in spite of high daily needs for growth seems to be very good.

The amount of vitamin B which can profitably be taken is undoubtedly more than will suffice to attain a normal rate of growth. For the best appetite and digestion a quantity 3 tablespoons of orange juice, 24 units from an egg yolk, 25 units from one slice of whole wheat bread, at least 15 units from a small serving of potato. With another vegetable besides potato at noon and an equally good dietary at home, there would seem to be an adequate supply of

vitamin B for children with good appetites and normal calorie intake. More recently a few children with poor appetites have received additional vitamin B in their orange or tomato juice, with decided benefit. We are inclined to think that children getting over 5 or 6 per cent of their total calories from sugar, over 10 per cent from fat, 35 to 40 per cent from white cereals and white bread, and less than 40 per cent from milk, are not likely to have enough vitamin B for best health.

Vitamin G has been so recently differentiated that we know less of relative requirement for this than for the vitamins already mentioned although we know it to be essential for good appetite and good growth. Milk, eggs, and liver are rich sources. Among vegetables, tomato, carrot, yellow turnip, spinach and collard greens appear to be excellent.

SUMMARY

A study has been made of the distribution of the calories contributed to the dietary by six food groups (1) Food from cereal grains, (2) Milk, (3) Fruits and vegetables, (4) Fats and oils, (5) Sugars, (6) Eggs and meats. This included 163 children from eighteen to forty-two months of age. The children received approximately half the day's total calories at the nursery school, and suggestions were made to the parents as to the best meals for the home to make the total food intake for the day satisfactory.

Children whose food intake showed a distribution of calories approximating the median value for each group had an excellent dietary, adequate in protein, calcium, phosphorus and vitamins, although not as high in iron and vitamin B as may on further investigation prove to be desirable. Children with less than 40 per cent of their total calories from milk did not have an optimal intake of calcium and sometimes not of phosphorus. Those with low milk tended to higher sugar and meat, foods which are deficient in growth promoting properties. The intake of fruits and vegetables is greater than a standard fomerly proposed for diets of low cost. It would seem from the study just made that over 15 per cent of the calories of these young children's diets may well come from carefully selected and prepared fruits and vegetables which will increase the intake of vitamins B and C and of iron. To provide for the regular daily addition of cod liver oil for the sake of its rich supply of vitamins A and D, a somewhat higher allowance of fat seems desirable. A new standard distribution for nursery school children is therefore suggested, as follows:

	Per cent of total calories
I. Foods from cereal grains	18–20
II. Milk	45–55
III. Fruits and vegetables	16–22
IV. Fats and oils	4–8
V. Sugars	1–3
VI. Eggs and meats	3–5

The data are summarized in table 3.

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A Two Year Record of Attendance and Colds in a Nursery School

HERBERT S. CONRAD AND MARY COVER JONES[1]

THE present study has grown from the collection of data, over a two-year period, on the attendance of children in a nursery school. The data show that a large percentage of absences are attributable to "colds." A statistical analysis indicates that these "colds" are probably infectious. The high incidence of colds, plus their infectious character, make this ailment one of the most important with which the modern nursery school must contend.

THE SAMPLE

The sample consists principally of the children enrolled in the nursery school of the Institute of Child Welfare, University of California. For confirmatory data on certain points, records of the children in the Children's Community (a cooperative nursery school in Berkeley) are also employed. Both of these schools draw nearly all their children from homes of superior economic and social status. The average enrollments and ages of the children in the two schools are presented in tables 1 and 2.

THE DATA

Full records of attendance are kept at the Nursery School of the Institute of Child Welfare. Children are examined daily as they enter the school by the Institute pediatrician, a nurse, or a member of the Nursery School staff. If there is evidence of a cold or other communicable disease (such as reddened throat, swollen lymph glands, or running nose), the child is sent home. If symptoms develop during the school day, the child is isolated until he can be called for. A child taken home before 10:30 a.m. is marked as absent; a child taken home later than 10:30 a.m. is marked as present. In the case of children kept at home by their parents, a telephone call on the first day of absence, and at intervals during the period of absence, serves as a check on the attendance records. The causes of absence are recorded daily under the headings: "Cold," "other illness," and "other causes." With the exception of colds, there have been no epidemics at the school.

At the Children's Community, the

[1] We wish to express our appreciation to Mrs. Pearl B. Crawford in the Institute of Child Welfare, and Mrs. P. S. Taylor, of the Children's Community, for the use of their records of attendance; to Miss Lina Hutson, for assistance in the statistical work; and to Dr. Harold E. Jones, Director of Research at the Institute of Child Welfare, for his careful criticism of the manuscript.

daily inspection of children for evidence of communicable diseases is made by a public health nurse. The records at the Children's Community, however, are not so complete as at the Institute school. For this reason, all absences at the Children's Community have in this paper been treated alike, no attempt being made to distinguish between absence due to colds or other causes.

TABLE 1

Age of children, and enrollment: Nursery School of the Institute of Child Welfare

DATES	AVERAGE ENROLLMENT	AVERAGE AGE OF CHILDREN AT BEGINNING OF SCHOOL TERM	RANGE OF AGES OF CHILDREN AT BEGINNING OF SCHOOL TERM
		months	*months*
October 10, 1927 to December 23, 1927*	20.9	28.2	21–38
January 9, 1928 to May 29, 1928*	25.0	33.4	20–48
August 20, 1928 to December 14, 1928*	27.6	38.4	24–55
January 7, 1929 to May 29, 1929**	24.7	32.1	19–50

* In session from 9:00 a.m. to 4:00 p.m., including a lunch-and-nap period averaging 3 to 3½ hours.

** In session from 9:00 a.m. to 1:00 p.m., including lunch.

TABLE 2

Age of children, and enrollment: The Children's Community

DATES	AVERAGE ENROLLMENT	AVERAGE AGE OF CHILDREN AT BEGINNING OF SCHOOL TERM	RANGE OF AGES OF CHILDREN AT BEGINNING OF SCHOOL TERM
		months	*months*
August 13, 1928 to December 14, 1928*	21.4	44.7	27–65
January 7, 1929 to May 31, 1929*	21.9	43.8	30–55

* In session from 9:00 a.m. to 1:00 p.m., including lunch.

RESULTS

Table 3 gives the per cent absent each term in the Institute school. The high per cent of absences (34.5) accords strikingly with that found in other nursery school groups—32.4 by Anderson (1) at Minneapolis, and 34.1 by Bott (2) at Toronto. Of the absences in these other schools, from about one-half to three-fourths were stated as due to colds; in the nursery school of the Institute of Child Welfare at Berkeley, about two-thirds of the absences were due to colds (the correlation between the per cent absent due to colds and the total per cent absent is, for a 325-day period at the Institute school, .87), and only one-eighth were due to other illnesses.

At the Children's Community, the percentage of absence is somewhat lower, averaging 26.6 per cent (table 4). At least part of this lower per cent is due to the fact that several

mothers officially withdrew their children during a long illness, and reentered them when they were fully recovered. Since these children are excluded from the computation during the period when they are withdrawn, the per cent absent is of course low-

tables 3 and 4, and in the reports of other investigators, challenges further analysis. In the present paper we are particularly concerned to discover if the high incidence of colds can in any way be attributed to the nursery school itself—whether through over-

TABLE 3

Percentage absent: Nursery School of the Institute of Child Welfare

PERIOD	POSSIBLE ATTENDANCE (PUPIL-DAYS)	ABSENCES			
		Due to colds	Due to other illnesses	Due to other causes	Total absence
		per cent	*per cent*	*per cent*	*per cent*
October 10, 1927 to December 23, 1927	1,106	19.6	3.4	5.2	28.2
January 9, 1928 to May 29, 1928	2,402	26.1	6.8	8.7	41.5
Total period	3,508	24.0	5.8	7.6	37.3
August 20, 1928 to December 14, 1928	2,204	21.6	4.3	4.8	30.6
January 7, 1929 to May 29, 1929	2,372	24.4	3.2	6.2	33.8
Total period	4,576	23.0	3.7	5.5	32.3
Total for 2-year period	8,084	23.5	4.6	6.4	34.5

TABLE 4

Percentage absent: The Children's Community

PERIOD	POSSIBLE ATTENDANCE (PUPIL-DAYS)	TOTAL ABSENCES (PUPIL-DAYS)
		per cent
August 13, 1928 to December 14, 1928	1,822	24.5
January 7, 1929 to May 31, 1929	2,100	28.4
Total period	3,922	26.6

ered. A further probable factor is the greater average age of the enrollment at the Children's Community (cf. tables 1 and 2).

Statistical analysis of the high per cent of absence due to colds: cycles, trends, and the effect of vacations

The high frequency of colds among nursery school children indicated in

stimulation and fatigue of the children, or through group-infection.

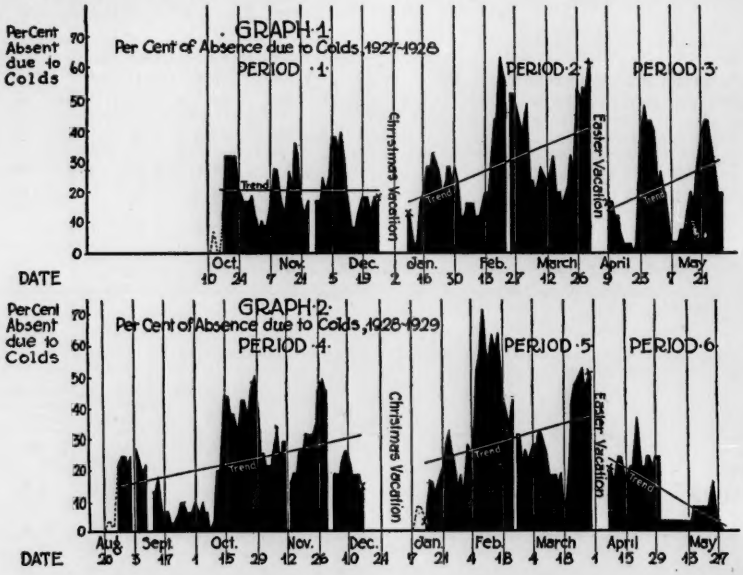
In Graphs 1 and 2 we present, for each school day in a two-year period, the percentage of children absent because of colds. Particular attention is called to the cyclical character of the curves—especially clear in Periods II, III, and V. If the reader will visually *connect* the various periods (e.g., II

and III), the impression of cyclical character is confirmed.

We assume that the cycles of per cent absent due to colds, are caused by cycles of fresh colds. A possible alternative explanation, however, is that the incidence-rate of colds among nursery school children remains more or less constant: it is the time required for recovery and return to the nursery school, that varies cyclically. This latter explanation obviously lacks the plausibility of the theory of cycles of incidence. Possibly, of course, both the rate of incidence and the rate of recovery vary cyclically, the one more or less independently of the other. So long, however, as it is admitted that the cycles in Graphs 1 and 2 are at least partially caused by cycles in the incidence of fresh colds, the argument in the subsequent pages of this article will remain valid.

With our present data we have not attempted to plot the incidence of *fresh* colds for each day of the two-year period, because in the case of a rapidly recurring condition (such as a "cold" among nursery school children), it becomes rather difficult to distinguish between what is a fresh condition, a relapse, or a continuation.

The trend-lines inserted in Graphs 1 and 2 have been fitted by the method of least squares. The trend-lines were obtained from the correlation between *time* (including Saturdays and Sundays) and *per cent absent due to colds.* In obtaining the correlations we omitted the data for the week of October 10–14, 1927; and for the weeks of August 20–24, 1928, and January 7–11, 1929. These are initial weeks of the school term, during which a considerable number of new children were admitted. The new children probably presented an abnormally low per cent of colds during the first week, since the mothers would not be likely to bring them to the school if they



were at all ill. We believed, upon the advice of the Institute pediatrician, that a week was long enough for the incidence of colds among the total enrollment again to become normal and typical. In four instances out of six, the trend is definitely upward—meaning that on the average, in the school-periods between vacations, the per cent of colds increases.

sure, indoor temperature, outdoor temperature, and relative humidity, failed to assign a definite causative influence to any of these factors. This is in accord with Anderson's report from the Institute of Child Welfare at the University of Minnesota, that for a seven-month period from November to May, extremes of temperature, wind, and sunshine are uncorrelated

TABLE 5

Decrease in absence following "long" vacations

DECREASE IN THE PER CENT OF ABSENCE DUE TO COLDS, FROM	AMOUNT OF DECREASE
	per cent
December 23, 1927 to January 9, 1928	5.2
March 30, 1928 to April 9, 1928	45.5
December 14, 1928 to January 14, 1929	11.4
March 28, 1929 to April 8, 1929	31.2
Average drop following a vacation*	19.6 ±.035†

* Weighted average, the weights being inversely proportional to the squares of the P.E.'s of the individual decreases. (The unweighted average is 23.3 per cent.)

† P.E. computed according to the formula recommended in reference (4). The true P.E., however, is lower than .035. For in the first place, a correlation undoubtedly exists between the per cent absent on the two dates compared (viz., the pre-vacation and post-vacation days); but this correlation can hardly be computed from our data, and was for this reason ignored in the formula for computing the P.E. In the second place, what is really wanted is the P.E. of the difference between the *levels around* the two dates compared. The reliability of this difference between levels would undoubtedly be greater than the reliability of the difference between the per cents absent on two calendar dates; but the reliability of the difference between levels has not been computed by us, in order not to complicate the statistical presentation.

The question arises at once as to whether these upward trends are due to the fact that the school periods coincide with calendar periods during which an average rise in colds in normal—due, that is, to seasonal conditions. What evidence we have, however, tends to minimize the importance of season and weather. In the first place, a preliminary investigation at the Institute for the period January-May 1928, of barometric pres-

with nursery-school attendance (1). In the second place, the curves in Graphs 1 and 2 do not (except in February) point to any very uniform seasonal factor. Thus, in the period following the Eastern vacation, colds *increase* in 1928, but decrease in 1929. These two periods after the Easter vacation are rather short; and in short periods there is danger that a trend may be unduly influenced by an incomplete cyclical movement (i.e., by a

half-wave). Inspection of the graphs indicates that this theoretical source of invalidity possibly affects the downward trend in Period VI, but not the upward trend of Period III. Similarly, in the initial period of the school year, colds remain *constant* (on the average) in 1927, but *increase* in 1928. This is again in accord with Anderson's report that "there is very little variation in the attendance [of nursery school children] from month to month (1)." In the third place, the percentage of absence due to colds drops after each vacation of a week or longer, *regardless* of the season. The exact amount of decrease is given in table 5. The average decrease of 20 per cent following a vacation is sufficiently striking to make comment unnecessary. The statistical details are given in the footnote to the table.

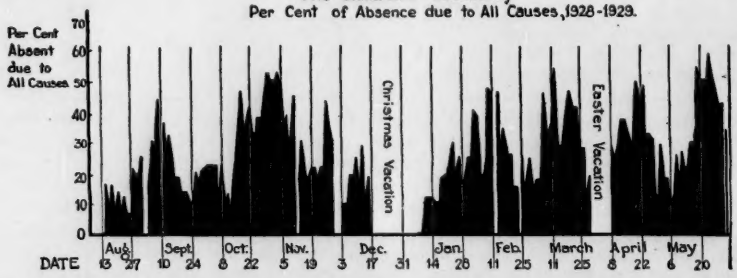
In Graph 3 we present, for the Children's Community, the per cent absent (due to all causes) in the period August 13, 1928 to May 27, 1929. This graph resembles the two already discussed for the Institute school, supporting the inferences derived from them. It is, however, somewhat more irregular, doubtless due to the heterogeneity of the causes of absence. Probably for the same reason, too, the presence of cycles of absence is less noticeable, and the effect of vacations is not uniform.

Further analysis of results: the weekly trend, and the effect of brief vacations

In the previous section it was noticed that colds tend to increase during a school period. We have been concerned to allocate this rise exactly. Does the rise take place chiefly between Friday and Monday, when the children are not in the nursery school? or does the rise occur mainly between Monday and Friday? The data necessary to answer these questions is contained in Graphs 1–2. In these graphs, all alternate Mondays have been labeled with their appropriate calendar date; thus, in Graph 1, Oct. 10 and 24 are alternate Mondays; the intermediate Monday, Oct. 17, is unlabeled.

Statistical reduction of the data in Graphs 1 and 2 with the omissions previously mentioned shows that for the two-year period in the Institute school, the average rise in colds from Monday to Friday is 3.5 per cent.

GRAPH·3·
The Children's Community
Per Cent of Absence due to All Causes, 1928-1929.



This average weekly rise is based on the regression line of Y on X—where X is the day of the week (Monday through Friday); and Y is the algebraic increase in the per cent of colds from Monday to the successive days of the week. The average rises from Monday to Tuesday, Monday to Wednesday, Monday to Thursday, and Monday to Friday are .93, .71, 2.39, and 3.13 per cent, respectively. These raw figures must not be confused with those derived by curve-fitting (i.e., use of the regression line of Y on X). The Pearson correlation between day-of-week and change in per cent absent due to colds is + .136 (n = 298); no reliable curvilinearity of regression was observed. It is clear that the cyclic character of the incidence of colds (see Graphs 1 and 2) seriously (and for our purposes, spuriously) diminishes the magnitude of the *correlation coefficient*, thus depriving it of much of its usual significance. This is much less true, however, of the *regression line*, from which the average weekly rise of 3.5 per cent was computed.

Anderson (1) reports no relation between the day of the week and the per cent attending that day at the Institute of Child Welfare of the University of Minnesota. Anderson's period of investigation was somewhat shorter than ours (covering 112 schooldays between November 12, 1925 and May 14, 1926).

The school régime does not appear to exert any clear influence on the average weekly rise. As a matter of fact, the greatest average weekly rise (7.8 per cent) occurs in the term January 14, 1929–May 29, 1929 (Periods V and VI, Graph 2); during this term the school hours were the shortest, offering the least opportunity for tiring through over-stimulation. In all except the last term (Periods V–VI), when the children were sent home at 1:00 p.m., the nursery-school routine included a long midday nap. If the mothers failed systematically to continue this program, this might account at least in part for the exceptionally high weekly rise in this period.

Along with the average weekly rise in the per cent absent due to colds, there occur more or less regular drops. These drops come, on the average, after vacations—especially after the relatively long, regular vacations, labeled as such in Graphs 1 and 2; but also after the irregular, brief vacations (such as Thanksgiving recess) indicated by breaks in the graphs; and after the regular Friday-to-Monday vacation (not shown in Graphs 1 and 2). The average drop in absence-due-to-colds following any brief vacation extending up to Monday (or to later in the week) and including the regular Friday-to-Monday interval when the children are not attending school is 3.2 per cent ± 1.06. This is the P.E. of the actual distribution of differences between the days compared (viz., the pre-vacation and the post-vacation day). For the Friday-to-Monday vacations exclusively, the average drop is 1.95 ± 1.09. For simplicity we here discuss this last figure only. The actual drop of 1.95 per cent fails to do the Friday-to-Monday vacation full justice. On the basis of the average 3.5 per cent rise

from Monday to Friday, one would expect a *continuation* of this rise from Friday to Monday. The precise amount of rise from Friday to Monday which we should expect, on the basis of the regression of Y on X is 2.6 per cent. Instead of this theoretical *rise*, however, we actually observe an average *drop* of 1.95 per cent,—making the *net* decrease due to the Friday-Monday vacation equal to 4.55 per cent.

Although other explanations suggest themselves, it is most harmonious with the indications of the data previously presented, to suppose that both the average weekly rise in absence and the drop after brief vacations are caused by the infectious nature of colds in the nursery school group.

One alternative explanation assumes that if a child has contracted a cold in the early part of the week, the mother (out of caution, or solicitude, or mere inertia) will fail to return the child to the nursery school until the beginning of the next week; whereas, had the child become well in the earlier part of the week, the mother would be more prompt in returning the child to nursery school. We are, in general, inclined to reject this explanation, because of such facts as the following: the mothers are eager to send their children to the nursery school; keeping a child at home often requires special arrangements; too often, mothers (on all days of the week) have been seen to wipe the noses of their children before morning inspection, possibly with intention to evade detection of the infectious condition; and finally, mothers very commonly attempted to return their children to the nursery school before the cold was (according to our standards) completely cured.

Another explanation of the Friday-to-Monday drop emphasizes the possibility of infection of the nursery school children by parents or siblings at home: the theory being that parents and siblings constitute a cumulatively increasing source of infection to the nursery school children during the week; whereas, over the week-end, these older members are themselves less exposed to colds, and consequently do not to the same extent disseminate infection. This theory seems to us improbable. For relatively few of the nursery school children have elder siblings; and it is not at all clear that such older siblings or the adult members of a household, would be less exposed over the week-end than during the week. Further, the theory would require that after a long vacation (involving increased home contact), an increase in absence due to colds should occur; whereas a decrease is actually observed (table 5).

The influence of age

Before formally presenting our interpretation of the long-time and short-time trends and cycles noted in the preceding sections, it may be well to clear from the field the possibly disturbing factor of chronological age. Do the very young children in the nursery school present a different picture from that of the older children? To answer this question we prepared a graph of the per cent absent due to colds among (a) the younger half of the nursery school children and (b) the older half. Examination of this graph reveals no important consistent difference between the two groups; except that the percentage of absence among the younger children appears occasionally to rise to higher peaks than among the older children. These facts agree with those of Anderson (1), who reports that "there is a slight but hardly significant tendency toward greater attendance among the older children," and that "there is greater variation in the attendance of the younger than there is among the older children." On the whole, in the age range considered, the differences between our younger and older groups are sufficiently slight to justify our treatment of the nursery school group as a unit regardless of age.

INTERPRETATIONS

The principal facts presented above are:

1. The high percentage of absence due to colds (tables 1 and 2).

2. The cyclical character of the incidence of colds (Graphs 1 and 2).

3. The upward trend (on the average) of the incidence of colds in the school periods between regular vacations (Graphs 1 and 2).

4. The rise in colds (on the average) from Monday to Friday.

5. The average drop in the per cent absent-due-to-colds after the "long" vacations (table 5).

6. The average drop in the per cent absent-due-to-colds after brief vacations, and even after the regular, weekly Friday-to-Monday vacation.

Although most of the above facts could probably be used by partisans of any one of the current theories concerning the causes of colds, the cyclical character of the incidence of colds would seem to accord best with the supposition that colds are infectious. If the absences due to colds were caused solely by over-stimulation and fatigue of the children by the nursery school regime, one might expect the high percentage of colds; one might perhaps expect the rise in colds during the week; and one might expect the drop in the percentage of colds after vacations. But one would hardly expect, and one could hardly explain the cyclical character of the incidence of colds. To explain this cyclical character, weather conditions appear insufficient (*vide supra*); and the same may be said for the suggestion of possible dietetic factors. Dr. Volney S. Cheyney's theory is that colds are caused by "a mild acidosis" . . . . "an altered metabolism and a systemic disturbance affecting all the fluids and secretions of the body" (3). Although fully accepting the importance of a proper acid-base equilibrium for the maintenance of health and resistance, and even conceding the possibility of a specific pathological effect of acidosis, we still find it very difficult to see why altered metabolism or acidosis as a cause of colds should occur in the particular cyclical form manifested in Graphs 1, 2, and 3.

The most plausible explanation for the cyclic (as well as all the other) characteristics of the incidence of colds appears to be the theory of group-infection.

This statistical analysis of colds in two nursery schools is not quite complete without reference to a control group composed of children of similar characteristics, who are not in nursery schools. Steps are being taken to provide such a group. In the meantime it may be noted that the children attending both the Institute School and the Community School, come from various parts of the city of Berkeley. The influence of any purely local factor of morbidity (other than attendance at the same nursery schools) seems for this reason sufficiently excluded.

All the published data on the attendance of children in nursery schools demonstrate beyond a doubt that the largest proportion of absence is due to "colds." Even if these colds caused no physiological injury whatever, there is little question that the disturbance of routine, and the pampering customarily bestowed on ailing children, is likely to cause significant psychological damage. Nursery schools would do well, therefore, to invite and promote

active research on the common cold. In the field of practical diagnosis, especially, nursery-school facilities would appear to be well suited for an intensive research program.

Meanwhile, in the absence of more specific information, the following practical measures for the prevention of group-infection in the nursery school are suggested: division of the total group into smaller, non-communicating units; rigid inspection of all children each morning upon entrance, and perhaps also at some other time in the school day; and routine disinfection of all common toys and play materials.

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A Technique for Diary Analysis[1]

ESTHER L. BELCHER

DIARY recording is one of the oldest methods of studying the behavior of children. The relative advantages and disadvantages of such records as compared to those secured by more systematic types of observation have been subjects for considerable discussion. Special merit is frequently claimed for the inclusive nature of diary observations. On the other hand, the systematic methods of observation of delimited types of behavior lend themselves more readily to control of the observer and to quantitative treatment and interpretation. The widespread use of diary methods necessitates some inquiry into the reliability of the data collected and into the uses which may be made of the results.

In the course of a study of the adjustment of a group of nursery school children to a public school kindergarten, the writer made a series of six observations from eight-thirty to nine-thirty o'clock each morning in each of two schools. All children were observed simultaneously. The writer's object was to secure a complete protocol of the teacher-child relationship, with no selective attention to any particular activity. The record consisted of a running account of events made in longhand in a notebook.

No plan for the treatment of the data was formulated in advance. Subsequent to making the observations, it was believed to be of interest to determine whether some of the principles evolved from time-sampling techniques could be applied in analyzing diary records. The method of analysis was suggested by Olson (3). The application of such a method to an analysis of data already secured in diary form has, of course, obvious limitations as compared to that of employing the time-sampling technique originally, i.e., in both the recording of observations and the study of results.

For the analysis of the diary account, a unit of measurement was defined in general as any manifestation of a specific item or category of behavior by a child during an observation sixty minutes in length. Two large categories were established, subdivided as follows:

1. Teacher-initiated activities
    a. Teacher gives *aid* to child. (Includes unsolicited physical or verbal help.)
    b. Teacher initiates *conversation* with child. (Includes "give and take" in remarks on general matters.)

[1] From the Child Development Laboratories of the University Elementary School, University of Michigan.

c. Teacher *criticizes* social or emotional behavior of child or use of materials.
d. Teacher gives definite *suggestion* to a child. (As in calling attention to routine.)
e. Teacher settles a *group conflict* among children.

In order to use material of this type in an analysis of teacher-child or child-teacher contacts, we would wish to know something concerning (1) the completeness of the notes taken, (2) the constancy and reliability of group and individual records, and (3) the number of time samples needed to get dependable descriptions of the behavior patterns of individual children. A statistical analysis of the diary in the described units yields some information on the last two problems.

TABLE 1

*Frequency count of each trait studied**

	SCHOOL A			SCHOOL B			SUMMARY		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
Teacher-initiated activities:									
Direction	28	39	67	22	13	35	50	52	102
Conversation	26	26	52	6	8	14	32	34	66
Criticism	13	14	27	19	13	32	32	27	60
Aid to child	20	18	38	13	7	20	33	25	58
Stimulation	27	16	43	1	2	3	28	18	46
Group conflict	8		8	4		4	12		12
Total	122	213	235	65	43	108	187	156	343
Child-initiated activities:									
Child asks aid	19	19	38	13	9	22	32	28	60
Questions	7	11	18	3	2	5	10	13	23
Volunteers	4	6	10	2	1	3	6	7	13
Conversation	5	1	6		1	1	5	2	7
Total	35	37	72	18	13	31	53	50	103
Number of children	13	19	32	15	12	27	28	31	59

* The maximum possible occurrence in each sub-classification under the conditions of the method is the number of children as shown in the last row of the table multiplied by six (the number of observations).

f. Teacher gives *stimulation* to guide child in making a choice.

2. Child-initiated activities
   a. The child asks for *aid*.
   b. The child starts a *conversation* with a teacher.
   c. The child *volunteers* some information.
   d. The child asks a direct *question* of the teacher.

By employing the defined categories, it became possible to go through the diary record and secure a frequency count for the various items (table 1). In the assignment of behavior to categories, there is probably a subjective factor which could be

tested by having a second person study the records in a similar fashion. Such a check was made by Andrus (1). It will be noted that the rank order of behavior items is roughly similar for boys and girls, and similar trends are maintained when the data are studied separately by schools. Consequently, there seems to be a basis for the prediction of group trends that can be revealed by the method. No attempt will be made here to present an analytic study of the facts of table 1. Perhaps the most obvious trend is the preponderance of teacher-initiated contacts in the total number of contacts.

The extent to which a single observation period will give reliable descriptions for individual children with respect to behavior in these categories can be studied by comparing the observations of one period with that of another. This is accomplished by setting up four-fold tables showing presence and absence of the behavior on each occasion for each child. When this is done for consecutive observations in the subdivisions of the teacher-initiated activities, it will be noted (table 2) that the coefficients (the method used is described by Kelly (2)) show considerable variability with a range from comparatively

TABLE 2

Coefficients of correlation between consecutive observations of teacher-initiated activities when analysis is made in terms of the subdivisions of the larger category

OBSERVATION PERIOD	SCHOOL A					SCHOOL B				
	Direction	Conversation	Criticism	Aid to child	Stimulation	Direction	Conversation	Criticism	Aid to child	Stimulation
1–2	.44	−.21	−.14	−.09	.00	.02	.00	.30	.52	.00
2–3	.04	.24	−.14	.25	.00	.32	−.13	.20	−.15	.00
3–4	−.09	.12	.60	.01	.11	.88	.04	.73	.20	.00
4–5	.37	.44	.83	−.15	.38	.80	.04	.72	.38	.00
5–6	.48	.03	.36	.16	.40	.89	−.09	.60	.54	.00

TABLE 3

Coefficients of correlation between consecutive observations of teacher-child and child-teacher contacts when the data are analyzed in terms of the major categories

OBSERVATION PERIODS COMPARED	SCHOOL A		SCHOOL B	
	Teacher-child	Child-teacher	Teacher-child	Child-teacher
1–2	.41	−.08	.41	.61
2–3	.23	.45	.33	.21
3–4	−.08	.10	.77	−.01
4–5	.31	.47	.67	−.09
5–6	.74	.24	.67	.73

TABLE 4

Reliability coefficients for teacher-initiated activities

BEHAVIOR	SCHOOL A		SCHOOL B	
	r Odd-even	Spearman-Brown prediction	r Odd-even	Spearman-Brown prediction
Direction	.78	.87	.51	.67
Conversation	.26	.41	.57	.74
Criticism	.76	.86	.62	.77
Aid to child	.02	.04	.58	.73
Stimulation	.48	.65	−.01	

high positive correlations to some correlations which are actually negative. More often than not, however, the coefficients seem to be positive and show that there is some consistency involved. In the material given, it would be difficult to isolate the effects of constancy of the behavior and reliability of the recording. It is fairly safe to assume, however, that a single diary record of the activities of a group of children may be quite erroneous in describing the behavior of an individual child within it. The situation appears to be improved somewhat if we are willing to limit our description to coarser categories (table 3). Smith (4) arrives at the same conclusion in a recent report in which a running account of a child's behavior has been made and analyzed in accordance with a modified form of time sampling measurement.

The advantage pointed out in connection with current studies to the effect that multiplication of observations employing a definite unit of behavior of a stated length of time results in increased reliabilities can be illustrated with the diary data. A score was computed for each child, based on the number of one-hour observation periods in which a particular category of behavior was shown. When the odd-numbered observations are compared with the even-numbered observations, it will be observed that negative correlations tend to disappear and appreciable correlations appear (table 4).

The claims for the value of diaries in synthetic interpretations of complex behavior patterns has not been touched upon. It should be noted that interrelationships within the diary record can be studied quantitatively by the same correlational methods as were used in the study of reliability, although the scientific value of the determinations may be lower than in systematic recording.

CONCLUSIONS

It would appear from the present analysis that diary recording of observations can yield usable data when we are interested in coarse units of behavior or trends within a group, and that diaries take on an increasing reliability for individual description as the diary records are multiplied. It is believed that diaries may also serve an exploratory use to suggest subsequent delimitations of behavior for an attack by the method of repeated short samples employing carefully defined categories.

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The Form and Function of Children's Questions

EDITH A. DAVIS

STATEMENT OF THE PROBLEM AND SUMMARY OF PREVIOUS INVESTIGATIONS

THE literature on child development nowhere yields an analysis of unselected spontaneous questions asked by a large number of children in the every-day home situation. This is surprising in view of the fact that we find interest in the subject ranging all the way from the genetic approach of Darwin (7), Taine (28), and others (15, 16, 22, 25) to the recent functional classification of Piaget (21). To Bain (1), Compayre (6), Sully (27), and Bohannon (2) the asking of questions is due to the instinct of curiosity. Woodworth (34) points out that the driving force is "curiosity regarding some particular thing." To Bohannon (2) inquisitiveness and curiosity express "defective self-control," or in Sully's (27) words "a mood of general mental discontent and peevishness." Hall and Smith (11) made a pioneer analysis of questions in connection with a study of curiosity in its relation to interest. Out of 1247 questionnaire descriptions of cases of curiosity, 477 were questions, but since they were reported from memory they could hardly be accurate in form or representative in content. The authors suggest that "a list of all the questions asked by a child during a week or a month would probably furnish material for a very fair guess at his interests and surroundings."

Some information as to frequency of questions may be obtained from the conversation records of the pioneer students of language development. Boyd (4) found that questions constituted 21.6 per cent of the 1250 remarks made by his daughter which he recorded annually from her second to her eighth birthday. Trettien (29) recorded 49 questions in one hour's observation, 22 per cent of the total conversation during the hour. The Brandenburgs (5) classified 18 per cent of their child's conversation as questions at thirty-eight months, 20 per cent at fifty-two months. The conversation of the two six-year-old boys studied by Piaget (21) yielded 17 and 13 per cent of questions. Nice (18) reports the lowest percentage found by any of these investigators, 11.2 per cent in the conversation of a forty-seven months old girl during a thirteen hour day.

The normative language studies of Smith (23) and McCarthy (17) throw further light on this point. They are of especial value since they deal with groups of children at successive age levels, instead of being confined to one or two individuals. Both these studies find that the percentage of questions

increased with age up to about five years, when the investigations were concluded. McCarthy's results, obtained from children carefully selected for age, sex and, socio-economic status, seem conclusive. Between the ages of thirty-six and fifty-four months, questions made up 14.4 per cent of the conversation of children in the upper socio-economic classes, 7 per cent of that of children in the lower socio-economic classes.

There has been much speculation as to the function of questioning in child development. Sully (27) finds two categories: (1) thirst for fact (what, how old, where, who, naming); (2) reason and cause (why), beginning at two, but most frequent from three to four years. The motivation may be "desire for order and connectedness" leading to anthropomorphism; teleological (cause, purpose); and a deeper "sense of perplexity, mystery, contradiction." Trettien (29) finds reason and cause linked with the anthropomorphic attitude and following the simpler questions of "fact, substance, action, place." Snyder (24) differentiated four categories, of which that begun by the interrogative words is last to appear and most complex. Her others are variations of the imperative, involving coöperation, permission, or approbation; questions of fact (counterpart of declaration); and a combination of question and exclamation.

Smith (23) adapted the Snyder classification, including requests for permission, approbation, or corroboration as a fifth category. Stern (25) describes two ages of questions, the naming period, reached in the second half of the second year, and the three to four year stage of when and why, directed mainly toward justification of commands and the desire to know. Hollingworth (12) places the Questioning Age from three to six and classifies the motivation as first, genuine curiosity; second, the desire to check up the child's own generalizations by the approval of one better informed; and third, getting and holding the attention of others. Piaget (21) has developed the most complete classification of questions to date, and reported it in such detail that it could be used in the present study. A teacher recorded 1125 of the spontaneous questions of a six year old boy on daily walks of about two hours extending over a ten months period. Unfortunately she began by recording only *Whys*, and midway changed her procedure so as to include all questions, thus making it impossible to calculate percentages for the various categories.

METHOD

The questions analyzed in this study were recorded by mothers attending study groups conducted by the Parental Education Department of the Institute of Child Welfare at the University of Minnesota. They were provided with blanks adequate for recording 50 questions, together with the explanatory data concerning time of day, person questioned, and similar information needed to make the questions intelligible. An instruction sheet was furnished with the blanks. Mothers were requested to start the record in the morning and as far as possible to continue without a break,

including everything of interrogative form except single word questions, which would often be so obscure in meaning as to make classification impossible. Periods such as nap, school, or outdoor play during which the child was not under the mother's observation, were to be omitted. Meaning was to be clarified by parenthetical explanation and underlining the emphasized word. Mothers were cautioned against polishing up the child's language, or attempting to elicit questions. The instructions were closely observed, and the records were carefully and very satisfactorily filled out.*

No attempt was made to control age, sex, or socio-economic status, save that the age limits were roughly set as three and twelve years.

Blanks were returned only by mothers belonging to the three upper socio-economic categories. It seems probable that such factors as interest in the study of children, leisure to indulge this interest, and the ability to fill out a fairly complicated blank, would necessarily operate to select a superior group of mothers. This situation made it impossible to verify the findings of other investigators (8, 10, 17) as to the marked differences in speech development between children of the upper and lower socio-economic classes, but the results of this study are not at variance with them. Fourteen of the 30 children whose blanks were completed most quickly have parents belonging to the professions.

A study of children's questions would not be complete without some comparison with the questions of

TABLE 1

Distribution of cases by age and sex and mean length of questions in words

AGE	BOYS				GIRLS				BOTH		
	Number of cases	Range of age	Mean age	Mean length	Number of cases	Range of age	Mean age	Mean length	Number of cases	Mean age	Mean length
years		*months*		*words*		*months*		*words*			*words*
3	2	34–41	37.5	5.09	5	32–39	37.2	5.61	7	37.3	5.46
4	10	42–51	46.3	6.24	5	48–53	50.6	6.32	15	47.7	6.27
5	7	54–61	57.7	6.27	4	55–62	57.7	6.71	11	57.8	6.43
6	7	66–76	71.0	6.89	8	67–76	71.0	6.97	15	71.0	6.93
7	6	79–89	84.8	6.51	7	80–88	82.6	6.90	13	83.6	6.72
8–12	7	97–140	114.1	6.28	5	95–131	111.6	6.64	12	113.1	6.43
Younger group	19	34–61	49.6	6.13	17	32–69	51.4	6.27	36	50.4	6.19
Older group	20	66–140	90.3	6.56	17	70–131	88.2	6.89	37	89.3	6.72
All.....	39	34–140	70.0	6.35	34	32–131	69.8	6.58	73	69.9	6.46

* From the Institute of Child Welfare, the University of Minnesota. The coöperation of the mothers who made this report possible is greatly appreciated. Grateful acknowledgment is also made to Dr. Esther McGinnis and the Parent Education staff for distributing blanks and interesting mothers, and to Dr. John E. Anderson, Dr. Florence Goodenough, and Dr. Mary Shirley for advice and assistance in preparing the material for publication.

adults. To obtain an adequate sampling of adult questions proved impossible, so following the example of Boyd (4), recourse was had to the printed page. Fifty questions were taken from the conversation of two male and two female characters of contemporary fiction, and these were supplemented by 300 questions extracted from legal testimony as published verbatim in newspapers. To what extent the fact-finding objective of the court situation held the questions to stereotyped forms as compared with random conversation is unknown, but the material has the merit of being actual spoken language recorded on the spot by experts. These 500 questions were classified like those of the children, and comparisons were made on a percentage basis.

RESULTS

Seventy-three records, 39 for boys, 34 for girls, were returned, making a total of 3,650 children's questions for analysis. The age distribution of subjects is given in table 1. The distribution is continuous, the four year group, for example, containing all children whose ages fall between three years six months and four years five months. Because of this fact, and the small and variable number of cases at each level, year by year comparisons like those made by McCarthy (17) are impossible, but comparisons on the basis of an older-younger division reveal certain age differences. When sex differences in the two groups are presented, the reader should bear in mind that the younger boys are slightly younger, the older boys slightly older, than the corresponding girls.

Length of questions in words

Nice (19) suggests that length of sentence affords a simple criterion of advance in mastery of speech, and McCarthy (17) found an increase from year to year in sentence length. Table 1 shows a similar slight but consistent increase in the length of questions. The difference in mean length between younger and older age groups is statistically significant (D/SD dif. 6.55), but the total range in length is very constant for both groups. The questions of girls are probably significantly longer than those of boys (D/ SD dif. 2.55). The distribution according to length in words for younger children, older children, and adults is shown in Fig. 1. The similarity of the curves suggests that the four to six word question is best suited to the expression of interrogation in the English language. Comparison of mean length shows that the questions of adults are significantly longer than those of children (D/SD dif. 9.70), but 42 per cent of the adult questions are of six words or less, and only 7 questions out of the 500 exceed the maximum length for the children. Fig. 2 compares the length for boys and girls, and here the curves are almost identical.

Time required to obtain fifty questions

Although instructions on this point were explicit, some recorders did not make it clear just how long the child was under observation. If John comes in from school at 3:30 p.m. and asks a question, but there is no further entry until 6:30 p.m., are we to assume that he asked no questions during that time? If the record goes on thus for

five or six days, we suspect that the mother is noting only the exceptional and striking questions, which is the very thing we wished to avoid. Sixty-one blanks (29 boys, 32 girls) were filled out accurately enough to make analysis of time possible, but the results as stated in table 2 were indefinite. The time range was from 30 minutes to 14 hours 5 minutes, but the

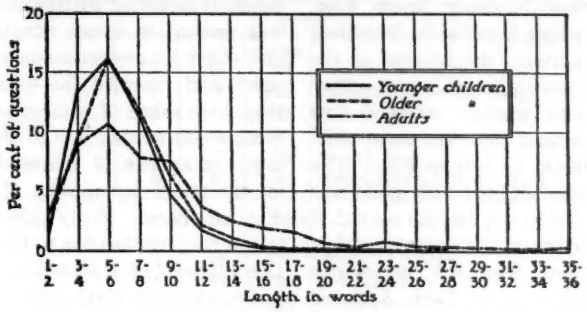

FIG. 1. PERCENTAGE DISTRIBUTION ACCORDING TO LENGTH OF QUESTIONS ASKED BY THREE AGE GROUPS

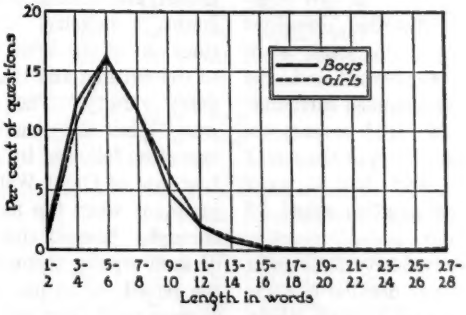

FIG. 2. COMPARISON BY SEX OF PERCENTAGE DISTRIBUTION OF CHILDREN'S QUESTION'S ACCORDING TO LENGTH

TABLE 2

Mean time required to obtain fifty questions using 61 records

	YOUNGER GROUP		OLDER GROUP		TOTAL RANGE
	hours	*minutes*	*hours*	*minutes*	
Boys	3	36	3	12	30 minutes to 10 hours 49 minutes
Girls	3	17	4	16	50 minutes to 14 hours 5 minutes
Both	3	26	3	44	

writer seriously doubts whether the time is accurately stated when the total period is many hours long. Question asking is variable, depending on the situation, the interest of the moment, fatigue, and many other factors. One mother returned two blanks obtained from the same child at an interval of two months. The time for obtaining the first quota was 9 hours 55 minutes, for the second, 5 hours, 15 minutes. It seems clear that the situation does not necessarily determine the rate. Table 3 shows that children 1 and 10 asked their questions on motor trips in 38 and 56 minutes respectively. On two occasions the writer recorded questions asked by boys on motor trips, when the parents were present and the child was under accustomed surroundings; yet child 26, aged seventy-six months, asked only 36 questions in 3 hours 45 minutes, and child 35, aged one hundred nine months, asked 20 questions in 5 hours and 45 minutes. In view of the inconclusive findings in regard to time it was decided to compare the 15 boys and 15 girls whose records were completed in the shortest time, since there is little likelihood of error where records are nearly or quite continuous. Table 3 indicates that boys ask questions faster than girls, but there is no evidence that the rate falls off with advancing age.

Circumstances under which questions were obtained

Table 3 also summarizes the situations under which the greater part of these continuous records were made. The circumstances seem fairly representative of the usual interests and activities of the ordinary child. One constant factor (of writing being done) was present in every situation save one, where the mother sat on a screened porch and recorded the questions as they were asked of a neighbor. How foreign this writing was to the child's usual experience of course depended on the every day routine of the individual home. Forty blanks contained no questions due to the writing, 13 contained one, 9 contained two, and so on, up to a maximum of twelve. In the last named instance, the questions were recorded during Sunday dinner, and writing at the table was of course a novelty. Eighty-six questions out of the 3,650 were attributed to the writing, and these were of very great variety. The most frequent was, 'What are you writing?' This was often followed by asking why the Institute of Child Welfare wanted to know, or when the mother would be through. Several children wished to do some writing themselves, to borrow the pencil, or to use the desk. One four-year-old boy at lunch asked, 'Do you see how I do like you—write in between bites?' Others wondered if the mother were writing a letter, a poem, a recipe, or an encyclopedia. Special note was made of these 86 questions, since there was no other factor common to all the situations under which questions were obtained, and no other unusual occurrence resulted from the recording. That it was not unusual to all the children is indicated by the fact that more than half the records were not influenced by it at all.

TABLE 3

Age, time required, and situation under which questions were asked, for 15 boys and 15 girls whose records were obtained in the shortest time

	CHILD	AGE	TIME	SITUATION
Boys				
		months	*minutes*	
Younger group	1	47	38	Motor-car trip down town
	2	47	117	Household routine, playing with brother
	3	48	48	Lunch hour
	4	48	110	Playing with new toys
	5	57	66	Lunch hour
	6	60	40	Discussing adult activities
Average		51.1	69.8	
Older group	7	61	103	Morning routine
	8	61	98	Solitary play
	9	66	60	Trip down-town, street-car
	10	72	56	Motor trip, Duluth to St. Paul
	11	74	85	Conversation on porch, adults and children
	12	79	65	Play with friend, age 89 months
	13	89	90	Solitary play
	14	89	30	First visit to friend, age 89 months
	15	108	45	Constructive play with friend 89 months
Average		66.5	70.2	
Average all		60.4	70.0	
Girls				
Younger group	A	32	118	Outdoor play, mainly in swing
	B	39	128	Household routine
	C	39	130	Sunday morning routine
	D	53	79	Morning routine
	E	55	129	Playing with sister, age 88 months
	F	62	109	Breakfast and lunch
	G	67	90	Play with friend, boy, age 90 months
	H	68	50	Solitary play, drawing
	I	69	51	Solitary play, talk with adult friend
Average		52.7	96.4	
Older group	J	73	81	Sunday dinner
	K	80	145	In bed with mumps
	L	88	64	Play with sister, age 55 months
	M	95	140	Morning routine and walk to school
	N	100	90	Sunday morning routine, making cookies
	O	131	122	Sunday morning routine
Average		94.5	107	
Average all		69.4	101.7	

Significance of difference in time for boys and girls (D/SD diff.) 3.03.
Eighty per cent of girls reached or exceeded median time for boys.

THE FORM OF QUESTIONS

There seem to be in English two principal ways of asking questions. They may begin with one of the interrogative words, or with an inflected form of one of the auxiliary verbs. Piaget (21, p. 219) calls the latter "simple questions," and does not differentiate the various auxiliaries in accordance with frequency of use. In English, however, these "simple questions" are nearly always expressed by means of the auxiliary *do*. Where the French say *Pensez-vous?* the English say, *Do you think?* The importance of these auxiliary verbs has been demonstrated by Stormzand and O'Shea (26) who found on analysis of 10,000 sentences selected from literature, newspapers, and school compositions that 68 per cent of the verbs used were irregular, and that the auxiliaries were used three times as often as all other irregular verbs put together. Since the inflection of these verbs has to be learned by long practice, and since their use expresses shades of meaning less essential than the main verb, we would expect the young child frequently to omit them altogether, and here lies a partial explanation of the increase in sentence length with advancing age. For the purposes of this study the emission of the interrogative word or of the expected auxiliary form renders a question incomplete. It is also possible to ask a question merely by the tone of the voice, as *You live in Minneapolis?* This sort of question was seldom found on the children's records. More frequent was the addition of *can't I*, or *doesn't it?* to a declarative sentence. McCarthy (17) did not classify these as questions, because she was following Piaget's socialized—egocentric classification. While questions are *ipse facto* socialized, many sentences of the type under consideration are egocentric in that they express the desire for approbation and corroboration noted by Snyder (24) and Smith (23), or for social contact described by Johnson (14). But to have told mothers to leave out such questions would have made instructions, already long, much too complicated, and would have introduced a large source of error. Moreover, Piaget, includes such questions in the study described in Chapter V (21) and if we accept Claparede's definition of a question as "the conscious realization of a problem" whose function is "an incitement to mental activity in a certain direction in view of readjustment" there is justification for such a course. If complete certainty existed, it is not likely that the question would have been asked. It is not easy to detect a difference between *Uncle Ed lives in Chicago, doesn't he?*, and *Doesn't Uncle Ed live in Chicago?* especially from the written form. Such questions have been listed separately under the heading Declarative plus Interrogative. The percentage distribution of questions among these four categories were tabulated. Boys are more likely than girls to begin their questions with interrogatives (D/SD dif. 3.31); girls are more likely than boys to use the auxiliary verbs. Adults use fewer interrogatives and more auxiliaries than children, hence the sex difference may be due to the slight superiority of girls in language development which has been demonstrated in other studies. On the other

hand, boys ask more questions involving cause or explanation, and usually begun by *why, what for, what makes,* or *how,* while girls were found to ask more questions involving permission, and other social relations, which begin with *may I, shall I,* and similar phrases. In short, the obtained difference in question form may be the result of unequal ability in handling the instrument of language, or of dissimilarity in the interests motivating expression. The fact that older girls use a significantly greater number of auxiliaries and smaller number of interrogatives than younger girls (D/SD dif. 3.65, 3.35) suggests that both maturation and training are involved.

Adults are more prone than children to omit the interrogative word, or the auxiliary form which expresses interrogation. This was more marked in the questions taken from fiction than in the legal testimony. The inflected forms of the auxiliaries seem to be much more frequently omitted than the interrogatives by both children and adults. The obvious interpretation is that the adult, having mastered inflection, leaves out non-essential words to save time, while the child who is still having difficulty with the precise shades of meaning conveyed by mood and tense, is painstaking in putting them in. The use of the declarative-plus-interrogative form seems to be an individual rather than a sex or age characteristic, although it is possible that situation and mood may have some bearing.

We would expect questions begun by auxiliary verbs to be longer than those begun by interrogatives, and this was found to be the case.

FUNCTIONAL ANALYSIS

In making a functional analysis of the questions Piaget's classification system was followed, with the addition of a category for social relation and one for rhetorical question. These changes were necessitated by the greater variety and complexity of situations under which these questions arose, and perhaps by the greater freedom of the American parent-child as compared with the French teacher-pupil relationship. That Piaget's scale is a usable instrument is indicated by the score-rescore reliability of .88 obtained by the writer while still in the early stages of the work of classification. Similarly, a colleague who has never read Piaget's book and who was asked to classify the 86 questions mentioned above as arising from the child's reaction to writing, questions which were much more difficult to classify than a random sampling, did the scoring with a relability of .77. The doubtful cases fell for the most part in the categories of Reality and Classifications, in which the distinctions are sometimes finely drawn. Confusion of causal, action, or social questions almost never occurred. In general the scale was satisfactory.

The results of the classification according to function are shown in Figs. 3 and 4. The distribution for both age and sex is surprisingly constant. As we would expect because of the small number of questions per child the standard deviation for the categories is always large. Thus, questions of cause ranged from 0 to 22; of social relations, from 0 to 25. Although there are few differences between categories which are statistically significant, there

are several which are of interest as indicating trends. Boys ask more questions of causal explanation than girls (D/SD dif. 3.07); they also ask more questions involving classification (D/SD dif. 2.03) and definition (D/SD dif. 2.95). Girls, however, ask more questions involving social relations than boys (D/SD dif. 3.04). Younger children ask more questions of cause than older children (D/SD dif. 2.13). This finding, to the earlier writers (3, 13, 20, 27, 32, 33) would constitute proof as to the crippling effect of the school system and social pressure on the spontaneity of language, but the data offer no evidence that the rate of question asking declines with age. Reference to the distribution of causal questions by years does show that a drop occurs at about the time the child is learning to read. Certainly it is just as probable that reading affords a new opportunity of finding out things, as that the child is discouraged by the attitude of adults. Questions of calculation apparently receive an impetus with the beginning

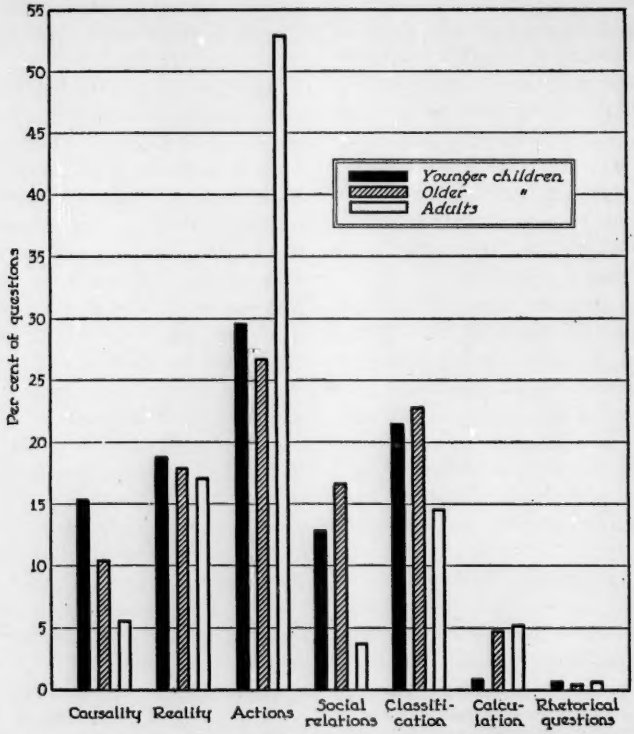

FIG. 3. PERCENTAGE DISTRIBUTION AMONG THE FUNCTIONAL CATEGORIES OF QUESTIONS ASKED BY THREE AGE GROUPS

of the school age, although the increase is not statistically significant. Boys may ask more questions in regard to meaning of words because they have rather more difficulty than girls in acquiring vocabulary.

Analysis of the data shows that the difference between boys and girls in the number of questions involving social relations lies for the most part in the much greater number of permissions and questions showing a subordination of self to others on the part of the girls such as, *'Shall I help you make the beds?'* This may be the result of the situation involved, or may mean earlier socialization of girls in regard to their relations with others. The small percentage of causal and social relations questions asked by adults may be in part the result of the situation, but the relative importance of the categories was the same for the questions taken from fiction and for those taken from legal testimony.

Analysis of the functional categories by length yields statistical confirmation of some obvious facts. It is apparent that more words are required to ask *Why do you write so fast?* or *Are we all going for a walk through the park?* than *Is this red?* or *What does "obsolete" mean?* That is, we would expect questions of Causality and Actions to be longer than questions of Reality and Classification, and this is true at all ages and for both boys and girls.

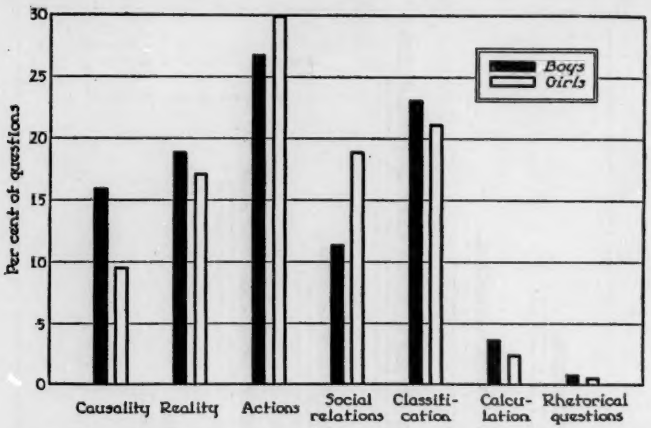

FIG. 4. PERCENTAGE DISTRIBUTION AMONG THE FUNCTIONAL CATEGORIES OF QUESTIONS ASKED BY BOYS AND GIRLS

PERSONS QUESTIONED

Piaget (21) concludes that children are prone to question other children in regard to actions and intentions, or "the factual aspect of reality," whereas questions asked of an adult concern causes and motives. In order to test this point, questions were classified according to the persons addressed. The divisions were mothers, fathers, all other adults (maids, plumbers, aunts,

grandfathers, even strangers on the street), children within a year and a half of the child's age, older children (the age of sixteen was arbitrarily taken as the point at which a child became an adult), younger children, animals, dolls, and no one in particular. In the final analysis all children were thrown together, as there semed to be no difference in type or length of questions asked of older or younger children. The percentage of questions asked of *other adults* varied greatly, because some records were made by aunts or adult friends, and there was always a chance factor involved in the selection of a certain time or place for recording questions. The most interesting result of this analysis is the large percentage of questions asked of the mother and the small but constant percentage asked of the father. No conclusions may be drawn, however, since in many instances recording was done in the partial or total absence of the father, nor do the records enable us to estimate to what extent the child had the opportunity of addressing the father. 18 girls and 21 boys asked no questions of the father.

The child-adult comparison suggested by Piaget yields only negligible differences, although it is true that the percentage of causal questions asked of children is slightly smaller, and the percentage of action questions slightly larger, than the corresponding percentages asked of adults. Boys address a large percentage of their questions of calculation to the father. Girls ask fewer questions of cause of the mother and of children than of the father and of other adults; boys, on the other hand, address more causal questions to the mother. All children nat-

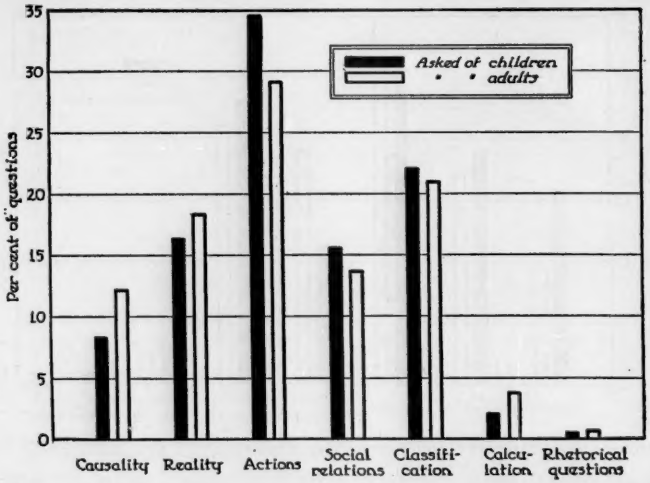

FIG. 5. PERCENTAGE DISTRIBUTION AMONG THE FUNCTIONAL CATEGORIES OF CHILDREN'S QUESTIONS ASKED OF CHILDREN AND OF ADULTS

urally enough address fewer questions of social relations to other adults than to their parents, whose authority they recognize. The percentage of such question asked of children, however, is only slightly below that of questions asked of parents, indicating that these children are well imbued with respect for the property and personality rights of other children, and are meticulous in requesting rather than commanding their cooperation. Fig. 5 compares the questions asked of children with those asked of adults.

The only statistically significant difference between questions asked of adults and those asked of children was in length, questions addressed to adults being longer (D/SD dif. 5.50).

SOURCE OF QUESTIONS

Of the 3650 questions, 87.8 per cent were attributed by the mothers to something in the immediate situation; 10.8 per cent to remembered or remote events; 1.4 per cent could not be accounted for by anything in the child's known experience. This classification is necessarily rough and there is no check on its reliability. Because of the widespread interest in the memory of young children the remote questions were studied in detail, but with little result. The mean number of such questions per child was 5.41, with a range from 0 to 18, and with no age or sex difference. Questions dealing with past events tend to fall into the categories of Reality and Actions, but on the whole the percentage distribution of Remote questions among the functional categories corresponds very closely to the total distribution. More Remote questions are asked of adults than of children, and Remote questions are significantly longer than immediate questions (D/SD dif. 5.25). Girls ask 14 per cent of their Remote questions of the father, and 70 per cent of the mother. Boys ask 1.4 per cent of the father, 77 per cent of the mother. There is a suggestion that Remote questions are prone to originate from conversation with adults.

ORIGIN OF QUESTIONS

It would seem very possible that some activities and situations are more likely to call out questions than others. Mothers were asked to classify the origin of each question as best they could under eight suggested headings, conversation of adults, conversation of children, stories, pictures, activities of children, activities of adults, personal routine, and miscellaneous. The records indicate that the mothers used great care in this classification, frequently clarifying their decisions by explanatory notes, hence their classsification was accepted even in cases where there was apparent contradiction. The question, *What time is it?* was found under nearly every one of the eight headings, since it might result from hearing adults discuss the hour of a concert, from anxiety over being late for school, from looking at a pictured clock, or from the desire to dress or undress in record time. Furthermore, conversation with children and adults may be going on simultaneously, and was sometimes so recorded. Because of this very elastic classification the data are considered only as suggestive of trends. Conversation with adults showed the

highest percentage of the activities calling out questions.

INTERESTS OF CHILDREN AS INDICATED BY QUESTIONS

An attempt was made to determine the interests of these children on the basis of their questions, as was suggested by Hall and Smith (11). The mothers were not asked for any impressions as to the children's interests, hence the question with an occasional explanatory note was the only source of information. Obscurity as to the interest involved made it necessary to eliminate 242 questions from consideration. The usual interests of children of the age range under consideration were tabulated from the Anderson-Goodenough Baby Book and the Lehman and Witty Play Quiz, and the questions checked against this list. A few items had to be added, and one (collecting) was not represented in the questions. The result was a list of 53 items some of which are themselves comprehensive. Thus, *Active and Competitive Play* included organized athletics and the activities of Boy Scouts as well as random outdoor play; *Constructive Play* might mean making doll clothes or building with Lincoln Logs. It was necessary to combine such items to keep the list within bounds and to obviate the necessity of classification under two headings where there seemed to be overlapping of interests. Any list of this kind is likely to be affected by personal bias, but in the majority of instances the interest is clear.

The interests were tabulated in two ways, the number of questions in which a certain interest could be detected, and the number of blanks on which it was found. When the items were ranked in the order of their frequency of occurrence from greatest to least, the coefficient of correlation (Spearman rank-order formula) was found to be 0.94, hence the results are given for one method only (the first). Age and sex differences where found were in keeping with previously established differences in play equipment, mental test scores, and educational achievement. Boys asked an average of 3.3 questions about machines (airplanes, motors, engines, trains, mechanical toys), girls 1.8 questions. The 20 older boys asked 6 questions in regard to school and homework, while the 17 older girls asked 31 questions. Girls asked slightly more questions in regard to household work (average 1.88, for boys 1.26). The younger boys asked 16 questions about personal appearance, the younger girls 17; the older boys 2, the older girls 21. Clothing irrespective of personal appearance ('Where are my other bloomers?' 'Do I need my sweater?') received more attention from girls (average 2.35 questions, boys 1.36). Boys asked an average of 1.74 questions in regard to natural history, excluding farming and pets, girls 1.15 questions. Natural phenomena, such as weather, storms, meteors accounted for 1.95 questions of boys, 1.47 girls. Questions in regard to meaning and use of language averaged 3.15 for boys, 2.82 for girls.

The degree of community of interests between boys and girls, and between older and younger children, was determined by computing the

coefficient of correlation (Spearman rank-order formula) between the frequency of occurrence of each item for boys and for girls. These indicated a decrease in community of interests between boys and girls with advancing age, and there is a suggestion that the difference between the interests of older and younger boys is greater than that between older and younger girls.

That a community of interests exists is further demonstrated by comparing the extremes of the distribution for boys and for girls. Six of the ten most frequent items and four of the ten least frequent items are found on both lists, and in no case is an item at one extreme for one sex and at the opposite extreme for the other.

Interest in theology and sex seems to be very slight. Very probably the findings of other investigators (11, 30) were affected by the fact that the records were made from memory. Obviously the amusing or unusual question is recalled, while the common place query in regard to some matter of every day life is not. These five questions concerning the nature of God were asked by five boys, all less than six years old:

God has wings to get down with, hasn't he?
Did Marje see God? (sister claimed she had)
Why does God give us pigs to eat?
Is God there? (in Ceylon)
Does God hear this? (blowing horn).

Forty-nine questions dealt with denominational differences and going to church, including these references to the Resurrection:

Is Jesus dead now?
Mother, what does "He is risen" mean?
How did the angel know Christ was risen?
Mother, why did that angel (picture) have a palm leaf in her hand when the ladies came to Jesus' grave?
How *did* Jesus get up?

Seventeen of these 49 questions were asked by one six year old boy, in regard to Catholics and convents.

Only 14 questions were found which could be classified as sex questions:

What is this skin for? (testicles—child in bath)
Will she have baby birds some day?
Does the baby calf come out of the mother?
Do they look like little seeds?
What do they look like when they are in the mother?
Who are I going to marry?
Will I ever marry when I grow up?
Do the baby deer come out of an egg like the chickens do?
Where do the baby deer come out of the mother deer?
Does it hurt the baby deer when it comes out of the mother deer?
What is this? (germ plasm in egg)
How did it get there?
What do they (little chickens) do when their mother leaves them?
You wouldn't *think*, would you, that this little speck could grow into a chicken?

SEQUENCES OF QUESTIONS

Every observer of children has noted the frequency with which a long series of questions is set off by a single remark or occurrence. To Wallon (31) this is pathological, and Faegre and Anderson (9) caution parents against trying to answer all their children's questions fully and completely. The records were analyzed to discover a possible age or sex difference in the number of questions on a single topic or logically following from a former question, and to determine whether

there is a tendency for sequences of questions to center around certain interests. Note was made of all cases where two consecutive questions were thus related, and if three or more consecutive questions dealt with a single topic or were logically interrelated these were listed as sequences and studied in detail. There were found to be 238 sequences. Every blank contained at least one sequence, and one blank yielded seven. Forty-four of the 50 questions on one blank were in sequence. The average length of sequences was 4.44 questions. The longest sequence was that of 17 questions on denominational differences mentioned above. There was one of 16 questions on making doll clothes, and one of 14 questions on the procedure at funerals.

Analysis by age and sex did not show any difference in the number of questions on a single topic. The mean number of consecutive questions on a topic for younger boys was 1.68; for younger girls 1.54; for older boys 1.52; and for older girls 1.58.

If we may assume that length of sequence is a rough measure of strength of interest, the next step is a comparison of the number and length of sequences concerning the various interest items with the frequency of such items for the total distribution. Sequences proved hard to classify, since the last question of the series may touch on a topic far removed from the original question. One boy began with *What kind of meat is this?* and ended with *Where will I work when I grow up?* yet the logical procedure from question to question was perfectly clear.

Classifying the sequences as well as possible, 41 of the 53 interest items seemed to serve as the central topic of a sequence. The 12 items not represented are sleeping, personal appearance, occupations, farming, memory and opinion, social relations, current events, sex, acts of affection, colors, God, dreams and fears. Money, fires, circuses, birthdays, other places and peoples, war, and helping are found in the boys' sequences but not in the girls'; jokes, electricity, school, government, funerals, diseases are found in the girls' but not in the boys.' These sex differences mean little, since the frequency of occurrence in one sex but not in the other is never greater than two.

This analysis of sequences according to the interest involved yields nothing conclusive, but there is a suggestion that for this group of children a long series of questions results from an unusual occurrence or novel bit of conversation, rather than from the desire to attract attention or the lack of adjustment which is Wallon's explanation (31).

It might be expected that a connection would be found between the type of question beginning a sequence and the length and general topic of the sequence. When a child asks a causal question is he in a "frame of mind" which leads him to continue asking questions? Analysis of the initial questions of sequences yields no evidence that this is the case. The first questions fall into the functional categories in very nearly the proportions obtained for the total distribution, and no one type of question tends to produce long or short sequences. These findings like those of the other analyses indicate that children are motivated

to ask series of questions by actual interest in something going on. There is no temporary "set" toward classification, causation, or merely getting attention.

SUMMARY AND CONCLUSION

Further study of children's questions along many lines is needed before any definite conclusions can be drawn. The data analyzed here indicate that the child in the present day American home of the upper socio-economic levels employs questioning, as does the ordinary adult, because it is an efficient and convenient means of extracting satisfaction from contact with other people, acquiring information about external reality, perfecting his command of the instrument of language, and achieving adaptation to the physical and social environment in which he finds himself.

The findings of this study may be summarized as follows:

1. Analysis was made of 3650 questions asked by 73 children between the ages of three and twelve years, and recorded at the time of asking. For purposes of comparison 500 questions asked by adults were taken from printed material.

2. Boys asked questions at a faster rate than girls but younger children did not ask them faster than older children.

3. The length in words of the questions increased with age. Girls' questions were somewhat longer than boys' questions. Questions of 4 to 6 words were characteristic of both children and adults.

4. Boys more often than girls began their questions with interrogative words; girls more often than boys began their questions with inflected forms of the auxiliary verbs. The use of questions declarative in form with the addition of an interrogative phrase, or the omission of the interrogative, seemed to be an individual rather than a sex or age characteristic.

5. Boys asked more questions involving causal explanation than girls; girls asked more questions on social relations than boys.

6. Causal and action questions were most frequently 6 words in length, questions on reality and social relations 5 words, those on classification 4 words.

7. Eighty-six per cent of the questions were asked of adults, thirteen per cent of children. Questions asked of adults were longer than those asked of children, but there was no conclusive evidence of a difference in type of question addressed to adults.

8. Eighty-eight per cent of the questions seemed to result from the immediate situation, eleven per cent from remote events. Remote questions were longer than other questions and were asked of adults more often than of children.

9. The interests of boys and girls as indicated by their questions seemed to be very similar. The difference between boys and girls increased with age, and the interests of boys changed with age more than those of girls.

10. There were no age nor sex differences in the tendency to ask a series of logically related questions starting from a single topic. Although a novel occurrence seemed more likely to call out a very long series of questions, any of the ordinary situations might serve as a starting point for such a series.

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Brief Reports

Lessons in Child Training Gleaned from Idiots*

IDIOCY, with its unhappy associations, provides, under a cloak of imperfection, many interesting facts about personality and intelligence. The scientific study of idiocy reveals implications for training and suggestions for understanding not only the idiot child but also the normal infant whose mentality is quantitively comparable to that of the idiot. At least, such is the conclusion drawn from a group of experimental studies of idiot behavior, conducted at The Training School at Vineland, with a group of twelve idiot children as subjects.

These idiot children, according to standard mental tests, were of the same general ability as normal preschool children. Preschool children, however, mature so rapidly that their behavior is a result of both growth and training, while the idiot remains indefinitely at the same level, and significant improvement may be attributed to training alone.

This fact enables us to observe training results in the idiot which, in the preschool child, are obscured or confused by his rapid growth. In other words, the idiot child presents a slow-motion picture of the rapidly maturing preschool child, and thereby reveals many facts impossible to observe among preschool children themselves.

Like babies, idiots have learned to rely upon adult attention to satisfy their wants. Fruit is handed to them in prepared form, toys are placed within easy reach, and the only test of their actual ability comes in their spontaneous play, when adults are not in constant attendance. At such times their meager intelligence, initiative and imagination are summoned to action, only to be distracted by a passing playmate, a bright color or a sudden noise. With some, attention shifts from one object to another without logical sequence, and their activity, on the whole, seems random and unorganized. Others of the group may become so engrossed in a single activity, such as buttoning a certain button or raveling out a thread, that their distractibility assumes opposite proportions.

Unlike normal babies, however, idiot children never outgrow this period of dependence and distractibility, except as they are trained to capitalize their meager talents.

Inasmuch as language represents the greatest divergence between the idiot and the preschool child, we sought to use situations entirely devoid of the language factor. Such situations

* These studies were completed under two financial grants from the Elmhirst Fund while the author was Research Fellow, The Training School at Vineland New Jersey. She is now Research Assistant, The Mooseheart Laboratory for Child Research, Mooseheart, Illinois.

seemed more accurately to measure the capabilities of the levels of two to three years. Another advantage in the elimination of language was the avoidance of personality differences among teachers or observers. Children will frequently respond to the mother when the same commands, given by another person, elicit no response. Likewise, different teachers often obtain different returns from training the same children. We were interested in seeing what the child could and would do of his own accord, and what elements in the situation influenced his reactions, aside from adult influences. Therefore, the use of language and the presence of adult observers were eliminated so far as the child was concerned.

Records were kept by an observer, watching through a one-way-vision screen. Such a screen, by the way, might be an interesting and useful addition to every nursery. A mother frequently breaks up a happy play period merely by her presence, which distracts the child from the task at hand. By the use of a one-way-vision screen in those early years when constant supervision is necessary, the child might be, apparently, left alone to amuse himself, thereby developing resourcefulness and independence that will be priceless in years to come.

For these studies we devised problems, simple to the adult, but of sufficient difficulty to the idiot to permit observation and analysis of his behavior and its relation to the problem. In the first problem, a large, brightly colored ball, a favorite toy, was suspended from the ceiling, and boxes, varying in height, were scattered about the room. In order to obtain the ball it was necessary for the child to stack the boxes under it and climb upon them.

Nearly every child, upon entering the room, immediately saw the ball suspended from the ceiling and was attracted to it. Some stood by apathetically, looking up at the ball; several ran toward it, jumping and reaching; some looked for a means of solution; others whimpered and cried for their desires, without any spontaneous effort; and still others, perfectly capable of making the solution, waited until they were told to go ahead. George, whose mental age was only 18 months, ran toward the ball, reaching for it. He ignored the box completely. After several unsuccessful trials, the box was placed beneath the ball for him. He ran toward the ball and climbed on the box, but immediately became so engrossed in climbing on and off the box that, although the ball was now within his reach, he ignored it. George, like many other children (and adults) had become so distracted by the method that he lost sight of the end itself. Just as a child puts in and pulls out the laces of his shoe from sheer joy in the accomplishment, George climbed on and off the box. Before he could obtain the ball it was necessary for someone or something to remind him of his original goal. *The final achievement desired must be kept in the mind of the child of this level, and must receive his constant attention.*

One means of centering or increasing the child's attention was to increase the incentive. After three trials of ten minutes each, if the child had obviously exhausted all his possibilities

of successful solution, he was taken from the room. The ball was then supplemented by the addition of a cookie, to stimulate the child to greater effort. This increase in incentive proved highly successful. Children who had ceased striving for the ball and had begun playing with the boxes now renewed their efforts toward the ball and frequently obtained it. Some subjects, however, failed the problems even with the addition of a cookie to the lure. In these cases, we substituted a banana for the ball and cookie and awaited results. Buster, who had stood on two boxes but never three, because of obvious fear reactions, calmly piled three boxes together when the banana was offered. Not only did he stand upon them to obtain the fruit, but also while he ate it.

The increased incentive was not tried until it seemed apparent that the child was exerting every effort and that the problem was really beyond his ability. Yet, with the increased incentive, the problem was solved. This principal may be applied to the every-day problems of normal children. Why should a child learn to dress himself, for example, if failure brings attention and help, while success brings only momentary praise? *It is wrong to assume that a child's failure to learn is due to sheer stupidity until every possibility of increasing the incentive has been exhausted.*

Carl became confused when the solution offered two possibilities. The problem called for two half-cube boxes to be piled, one upon the other, but Carl saw also the possibility of standing the larger box on end, and using it alone. The boxes were so constructed that they could not stand on end without rocking, which made climbing upon them impossible. Carl tried again and again to climb upon the unsteady box, but failed repeatedly. Finally, the box fell on its base and he tried it that way. Finding it inadequate, he immediately brought the second box and placed it on the first, climbed up and obtained the ball. It seemed obvious from his behavior that the second solution, although much easier, did not occur to him as long as he was trying the first.

Children often become confused if there are too many possible lines of activity. *Training should be so systematized as to allow only one solution to each problem until it is too thoroughly learned to be confused with alternatives.*

In a second series of problems, the ball was placed in a pen, and sticks were supplied with which the child might obtain the ball. In these problems, like those utilizing the boxes, failure was often replaced by success when changes were made in incentive. Solutions were easiest when the necessary implements were in visual proximity with the lure. If the stick was inside the pen it was used more readily than when it was outside the pen. Although the stick stood against the outside of the pen, Jimmy struggled and reached repeatedly for the ball, lying prone in order to use his maximum arm length. Finally he gave up and began playing with the stick. Soon, however, he stopped, with stick in hand, to look at the ball again. As he did so, his eyes fell upon the stick and immediately he used it to obtain the ball. The stick in his

hand was closer to the ball than it had been against the wall, and probably made the solution easier.

A more difficult problem with the sticks involved joining two short bamboo rods in order to make one long enough to reach the ball. Two children were able to do this when the sticks were laid side by side, but both failed when the sticks were placed on opposite sides of the pen.

These incidents reveal the importance of a logical presentation of materials for maximum training results. The normal preschool child becomes confused by a mass of unorganized materials before him. Gradually, however, the mass clears as he develops greater comprehension. *The slow or retarded child, however, must have his world organized more systematically by his teachers if he is to approach the standard of training of his more precocious playmates.*

"Conditioning," a term which has become common by practical usage, was taken as the basis of the third study. The idiot children were "conditioned" to the smaller of two boxes; that is, after repeated trials, they established a preference for the smaller box, under which a cookie had been placed. The process of building up such an association is identical with that which occurs daily in the lives of young normal children. They choose certain forms of behavior because of pleasant associations, and discard other forms because of unpleasant associations. Habits or fears that seem impossible to overcome are often established in just such a way, and the association must be broken down before the act can be eliminated. How such an association could be most easily built up and broken down was the object of this study.

Each child was admitted alone to a room barren of all furniture except a table, on which there were two boxes, differing in size. No instructions were given, but after from 2 to 5 minutes every child had investigated the boxes and found, under the smaller, a cookie. After a varying number of trials, depending on the subject, the children learned to choose the small box immediately upon entering the room.

During the conditioning process it was noted that choices were made first on a position basis, that is, the box always on the right or always on the left was chosen consistently for a number of trials, regardless of its size. Most of these preferences were spontaneously overcome by the subjects themselves, although three children might have continued indefinitely except for a change in presenting the incentive. In these cases, half the cookie was placed on, and half under, the box until the child's attention was attracted to the small box. This made the association immediate rather than dependent upon memory of the previous trial, and is merely another instance of keeping the goal before the child throughout the learning period. As noted in the problem-solving study, children at this level of intelligence are extremely distractible.

Having built up an association between the small box and the cookie, the problem was reversed. The cookie was now placed under the large box, and in order to obtain it the child had first to inhibit the previously established choice. Throughout these prob-

lems only one choice was allowed in each trial. Therefore, the child could not succeed by a trial and error method but must definitely choose the box opposite the one to which he had been conditioned.

Every child continued, for a few days at least, to choose the small box. Then the preference began to be spontaneously overcome. It was interesting to note that the children who had taken the longest time to establish the first preference overcame it most easily, while those who had learned with relative ease persisted in their learned choice. This suggests that, *for those children who learn most readily, it is even more important to see that the correct habits are established first, since the ability to retain is apt to be as strong as the ability to learn.*

For two of the children, it was necessary to use an exposed cookie, placing it on the opposite box before their attention was drawn from that which they had learned to choose. Another interesting implication which comes from this observation of retentiveness is that the incentive is necessary in order to start an act and keep it up until learned, but, once having learned it, the child continues the act with less and less incentive. In other words, we may give a child much incentive for dressing himself, for example, by praising him or by offering other rewards, but these artificial incentives may be gradually withdrawn with the expectation that the child will continue to dress himself. The same holds true in conditioning a child favorably to the habit of obedience. *It is just as simple to build up pleasant associations around obedience as it is to build up unpleasant ones around disobedience, and after such conditioning the child should continue obedient as a matter of course.*

There were, of course, frequent failures, especially in the early stages of learning, and the reactions of the children after such failures were most interesting. Dick stamped his foot and banged the box into place. Bobby said, in a most disappointed tone, "Ooh, no cookie!" Tim turned and left the room without comment, but then mistreated his playmates on regaining his group. Close observation showed that after successful performance Tim was very congenial and amenable, but after failure he became quite obstreperous.

Mothers and teachers are familiar with those occasions on which everything goes wrong for certain children. They are cross, impatient and ill-tempered. The cause, of course, may be physical, but it may also be a mental set acquired through failure earlier in the day. Children like Tim may go to school feeling disgruntled by an incident which occurred at home, or may come home aroused by an unpleasant incident which occurred in school. Failures, like other unpleasant incidents, are easily forgotten by the young child if followed by success, and thoughtfulness on the part of an adult can frequently arrange such an order of affairs. *It is only fair for those who handle children at least to save the pleasant incidents for parting, and to send the child happily to his next task.*

These incidental suggestions as to child behavior, imparted by the above studies, confirmed our expectation that from the slowly developing idiot child

we could obtain many valuable suggestions for training of both the idiot and the normal child. The field has now been entered, and there is no limit to the research which may follow. Studies of the types and effectiveness of incentives, the frequency and importance of certain personality differences, the relation between learning and extraneous factors in the environment, the results of experience and many other influential factors which efficient training must take into account, may follow these suggestive experiments in the field of idiocy.

CECELIA G. ALDRICH.

A Thumb Sucking Cure

THE problem of thumb sucking arose early in the life of my infant daughter. I recorded its progress and the results of attempts to cure the habit.

The sucking reflex was marked from birth. On day 18 I noted, "It strikes own fist, sucks it. Sometimes sucks breast and thumb or finger at feeding, until finger removed by mother." Progress toward the habit continued. Day 32: Sucks fist when hungry. 59: Sucked thumb when lost nipple. 64: Sometimes sucks thumb or one finger if lips strike it. Left hand in particular.

At this time I consulted Dr. Ethel Waring of the Cornell Nursery School, who advised me to make sure there was no nutritional defect, and to pull out the thumb, saying "Out," whenever it was inserted. My physician assured me that no nutritional accompaniment was evident. Later, however, we discovered that the child was overfed in amount and richness of milk. Eczema developed, and was entirely cured only by omitting cod liver oil and, after weaning, by giving skim milk.

Day 71: Sucks left thumb at times when hungry. Mother pulls out and says "Out." Gives left hand a ring to hold, or turns baby on right side. Baby often cries, throws left hand around. Has never sucked right thumb when observed. 78: Twice when sucking thumb, has pulled out when mother said "Out." Otherwise, has needed to have it taken out. 85: Right thumb now sucked when left tied up. Right sometimes tied up also. 99: Still sucks left thumb at times, but less often. Verbal "thumb out" will usually bring results if command given by mother, then toy handed to baby. 104: Thumb sucking less marked. Handles toys more and more during waking time. 124: Command "out" always brings thumb out. When approved by "good girl," baby smiles or laughs. 140: Thumb sucking only when sleepy, usually at night. Never takes out at command of person other than mother. 157: Pulled thumb out when father said "Out." 184: Took thumb out when Mrs. N— had said "Out" six times.

Thus, at six months, the night sucking remained a problem. There were occasional reversions during the day also, notably during weaning and at the appearance of teeth. Day 267:

The "Out" has become a game, the baby putting her thumb into her mouth and waiting for the command, then laughing as she responds. 290: Removes objects other than thumb at command "Out." Seldom seeks hands, which are covered, at night.

At one year the cure seemed almost complete. However, as warm weather made covered hands uncomfortable, they were again left uncovered during sleep. The habit was at once resumed. At one year and two months the baby was taught to cross her arms while going to sleep. I praised her when she crossed them, in imitation of myself. This made a game of the act, and I insured its continuance by staying beside the baby until she was asleep. For months, there remained a tendency to slip the thumb in at the moment of going to sleep. At one year and five months, the hands were again covered at night, as the weather was cooler. Two months later I noted that "I have not observed thumb sucking for two weeks, even when hands uncovered one warm night."

The habit has not reappeared, and is, I trust, fully overcome. The child is now three and a half years of age. Her teeth have been pronounced perfect by a dentist. She has slight adenoids, with a tendency to mouth breathing. They developed subsequent to the cessation of thumb sucking, and are not attributed to the habit by the examining physician. The callous which developed on the thumb disappeared readily, and the shape of the thumb is normal. The reader will note that the really effective method of handling the problem required the child's coöperation. The covering of the hands aided when she was asleep and unable to inhibit the action.

I may add that my second child, now one year old, has never contracted the habit to such a degree, although she has required constant discouragement. In her case, similar overfeeding at an early age was adjusted. For a short time, at about six months of age, she tended to suck the index finger of her right hand and still, if hurt, sucks this finger momentarily. She also tries at times to insert the finger into her mouth while going to sleep, ingeniously wriggling it through the neck of her sleeping bag. This is particularly true during periods of teething. She associates "out" with all forbidden things put to the mouth, rather than with the finger alone. I am now teaching her to hold a large doll in her arms while going to sleep—a variation of the arm crossing. Two other mothers to whom I related my experience found this an effective cure, as I did.

FLORENCE W. HAZZARD

A Study of the Development of Motor Coördination in an Infant Between the Ages of Fifty-eight and Sixty-seven Weeks

PROBLEM

THIS study was undertaken in the hope that the observers might be able to trace the stages of progress toward walking and the subsequent perfection of the coördinations involved in walking, in the case of a girl who was enrolled in the Vassar College Nursery School.

PROCEDURE

The development of motor coördination in an infant from the fifty second to the sixty eighth week of her life was studied by three observers. Running accounts of the motor activities were taken for at least one hour every day of her attendance at the Nursery School. In the report, the biographical data were divided into weekly levels, with significant notes from each week, to show the development of motor traits.

RESULTS

Pre-walking stages

The pre-walking stages include crawling and standing, as well as walking with help. Observation of the subject began in the fifty-fourth week of her life. At this time she was crawling and walking with help, though not very spontaneously, as the notes will show. She was also beginning to pull herself into a standing position. With constant improvement in coördination, this stage lasted until the beginning of the fifty-seventh week, when the subject took her first steps alone. Through the notes, divided into weekly levels, can be traced the sequential development in motor control which leads up to walking.

54th week

October 4. Crawled, pushing with right foot and left knee, one-sided. Reached for end of bed, sitting far from it. Pulled herself up steadily but let go immediately and sat down.

Allowed to walk into the bathroom holding on to adult's hand; steps short, legs spread far apart and swung from the hip, with almost no knee flexion. Feet flopped on floor, very flat.

October 7. T. stood her on feet on floor; she collapsed to sitting position instead of trying to walk. Began crawling, sometimes up on both feet and hands, feet walking and legs stiff, hips high.

T. stood her on floor. Crawled about four feet to a table. Pulled herself up by rolling over onto left knee, planting right foot, reaching edge of table with both hands, and pulling left foot coming into standing position last. Stood at the table a minute, feet wide apart, on their sides, toes curled. Took sideways steps. Crawled about ten feet to the playhouse and back again, alternating knees and feet. Crawled about fifteen feet to the toilet room, last half on hands and feet.

October 8. Pulled herself up to standing position with one hand. Outside, Miss W. took a yellow pan and held it out to M. H., then walked a little way from her, and she crept after, reaching for pan. If she got too far away, she lost interest.

Crawling after pan, she waddled on all fours, neither knee touching the ground. After crawling she sat down on left side first, because she used that side more in pushing when crawling.

October 10. Toes turned slightly outwards and body bent forward from hips when standing at a table. Crawled about with a cup in one hand, a plate in the other.

55th week

October 14. Crawled all the way into the bathroom on hands and feet. Sat still a great deal today. Later, refused to walk when held up. Shoes put on her today. From sitting position she flopped over to creep, but lay down flat. Later, drew feet and knees up and started creeping.

October 15. Walked along table leaning on it. Put feet together, then swung one foot out from hips, wide base.

56th week

October 21. Crawled up the long flight of steps on hands and knees. Same technique as in crawling, right side leading. Seemed tired as she reached the top. Crawled down steps almost backwards, getting on all fours sidewise, on each step. Crawled on hands and feet almost all the time during day.

October 22. Activity great and varied. Crawled upstairs, then across the big room. Followed Miss R around the room. Attention diverted to the children, and sat watching them. Pulled herself up at various tables, etc.

October 24. Very active. Outside, didn't stay on mat. Tried to crawl up a board and did so, with help. A ladder was lying on the ground. She climbed across it, then half the length, falling between the rungs.

57th week

October 29. Crawled quickly away, on feet, from toy. Quick back again. Picked it up in left hand, pushed it in front of her as she crawled. Got all mixed up in it.

Was picked up, put in front of doll-carriage, held from behind. Walked about twenty-steps—short steps, fairly narrow base, bending back and forth at the waist as she lost her balance. T. let go of her; she went two or three steps alone, acquired too much momentum, and toppled. Later, crawled all the way from the big room to the piano. At the piano, grabbed the leg from the foot-crawling position without use of knees, stiffened legs and got up.

October 31. Got going so fast on her hands and feet that she often slipped and fell on her stomach. Explored a great deal today, walking and crawling all around in behind piano. Slid a large block across the floor for about five feet. This required a considerable amount of push in the legs, and coordination of arm and leg movements.

Miss T. came to get her for washing. Said, "Come, baby." M. H. put up her arms; no results, so she crawled over.

Stood up for a second unsupported, then fell to a sitting position.

58th week

November 4. Stood by a chair, reached for toy I was playing with. Stood without support, wobbled and fell.

Positively running across the floor on hands and feet, arms and legs straight and stiff.

Very active this morning. Method of pulling self to standing position: squatted on both feet, pulled with right hand around leg of table and pushed with feet. Once on her feet, let go with hands, stood a minute alone, before putting hands on chair to walk around.

Stood with one hand on the arm of a little rocking-chair, rocking it gently to and fro. Showed great degree of balance by this.

Stood alone in middle of floor; waved arms with delight, but no steps.

Another time she was picked up and set on her feet and willingly started out walking. With support, went half-way across the big room. Feet well planted, far apart, and legs rather bowed, steps uneven and lurching. When support left her, she stood with arms out, fingers stiff, with very little swaying. Seemed just about to take a step. . . . dropped on the floor and crawled away.

Walking around between piano and piano-stool, holding on with first one hand and then the other, but quite casually. Hard to tell whether or not some of the steps were without support.

This was the day before M. H. took her first steps. It was a particularly active and significant day. This day and the days immediately preceding it showed a culmination of all the motor activities in the pre-walking stage. In the fifty-fourth week, pulling herself to a standing position was a long and difficult process. The amount of crawling done was small and covered short distances. An unwillingness to walk was shown on many occasions. In the fifty-fifth week, appeared the ability and desire to walk along the edge of a table. The proportion of crawling done on hands and knees became increasingly smaller during the fifty-sixth week, activity increased. By the fifty-seventh week, a great desire to walk with support was present. Skill in raising and lowering herself increased. Her hand and foot crawling method was improved so that speed was possible. Finally, in the beginning of the fifty-eighth week, standing alone was accomplished. She walked independently about from place to place, holding on to anything convenient. This activity almost entirely replaced crawling.

Walking

57th week

November 5. Walked for first time alone. Took three steps. Could almost run on her hands and feet. Pulled herself to a standing position with great ease and almost entirely with one hand. Could stand easily from sitting position on the floor by first kneeling, then standing on her feet, then pushing the rest of her body up by her hands.

November 6. Took fourteen steps alone.

58th week

November 7. Climbed over toy stove with hands holding onto toy bureau. First put one leg over the stove, then astride it, then after several attempts lifted other leg over.

After standing a long time looking at the fish bowl, she took two steps *backward*.

November 8. After lunch she crawled from the table to the doll's bureau in the playroom—about twenty feet—and then stood up by the bureau. She still found crawling a surer means of getting somewhere.

November 11. After lunch walked about fifteen steps twice with falls in between. She could stagger and catch her balance without falling. Her falls were abrupt, sometimes forward, sometimes backward. She held her arms up and forward as she walked. After becoming more accustomed to walking, she took thirty-nine steps, walking about twenty feet to her mother. She kept her eyes fixed straight before her on the object for which she was walking. Her legs were far apart feet picked up fairly high, steps not perfectly even.

59th week

November 13. Difficulty in walking after sitting down to eat. Dropped to her knees, crawled a few steps, then walked across the dining room. Then crawled a minute. Really walked very fast across playroom and then crawled very fast. Held cup in each hand when walking.

Legs held wide apart. Feet were not lifted very high and knees not bent. Her arms were held in front of her.

Had difficulty walking on rubber matting, because feet did not slide. Tried to look up at the light and fell backwards.

November 18. When walking slowly, sometimes put her left arm down at her side, instead of holding her hands forward.

E. took her by one hand and walked so fast that she practically ran for about five steps. Then she fell down flat.

Could turn quite slowly without losing her balance. Fell with less of a thump and in a more controlled way.

November 19. Was having bloomers put on, stood on the table with hands against wall and balanced first on one foot and then on the other. She clung to the table with her toes.

Almost ran three or four steps at a time.

Did not lose her balance when J. T. put her arms about her.

Stepped over P. G.'s leg without falling down.

Reached down and picked up something from the floor without losing her balance.

60th week

November 21. Had great difficulty in walking and even standing, with big blue sweater and leggings on.

Attempted to run away from some of the children, but lost her balance after running only about three steps.

November 22. Side-stepped in walking to keep her balance, showing greater coordination.

November 25. Pushed doll carriage with one hand.

J. H. walked by her very fast, and she lost her balance and fell. She was not yet perfectly sure of herself. Her feet were closer together and she could walk fairly fast.

Liked to walk in circles turning corners. But sometimes fell as her feet interfered with each other. Walked holding blocks in her hands.

61st week

December 21. Practically ran across the room to one of the teachers holding her arms out straight in front of her.

Could turn very sharply on one toe of one foot and did it often.

Tried to climb up on boxes, putting left foot up first, but did not get anywhere and soon gave it up.

Tried to wheel doll carriage and carry a book at same time, but found it too difficult and left the carriage.

Her steps were short; her arms quiet with her fingers spread out.

December 3. In attempting to lean over to pick things up from the floor, she fell over three times, but was successful finally. (On Nov. 19, she had been able to pick things up from the floor with apparently less difficulty.)

Walked with uneven steps, the right leg's swing being longer than that of the left leg. She twisted her body as she walked. Her fingers seemed more relaxed.

December 5. Walked along waving both arms up and down. The right arm went higher than the left and moved more freely.

She showed greater balance and less need of her arms to maintain it.

December 6. Carried book over her head and let it hang down her back.

63rd week

December 16. Walked for a long time holding a small cup in each hand. Then tried to pick up book from the floor, but found she could not with cup in hand, so left cup on floor.

Did not dare to get down from chair without help.

Legs wide apart when she got up from floor to a standing position but got them nearer together when walking.

December 17. Spun half way around quite fast on one foot.

December 19. Scuffed a little with her heels as she walked. Ran up to door and hit it so hard in her attempt to get it open that she bounced back and sat down.

66th week (after vacation)

January 8. Steps very short and feet close together.

January 9. Arms swung freely at sides, legs closer together and feet near ground,—not held high.

During the vacation period a decided advance in her walking ability could be noticed. It was a free, easy step and not the more staggering uneven steps that she had usually taken before.

Climbed up on a chair, first putting up one foot, then the other, helping herself by the table. Finally she stood up in the chair, but almost immediately fell over backward onto the floor.

This is the first time the observers had seen her climbing. The chair was a really high step for her.

67th week

January 13. Walked around holding a piece of wood in each hand, then took them back to where they belonged.

She stepped over a door sill with comparative ease. She had a real knowledge of distance and heights now.

68th week

January 16. Walked with her two arms straight up in the air with the forefingers pointed and looked straight up above her—or even up and slightly to the side, but found this too hard and lost her balance.

Her walk was still scuffling, sometimes with the heels and sometimes with the toes going down first.

At the age of sixteen months M. H. was able to accomplish the following tasks assigned to the level of eighteen months in the Gesell normative summary: walked alone; climbed chair or stair.

DONALDINE DUDLEY,
DOROTHY DUNCAN,
ESTHER SEARS.

A Study of the Effect of Daylight Saving Time Upon the Sleep of Young Children

PARENTS and teachers have a general impression that the change to daylight saving time causes loss of sleep among children. This loss may be due to the fact that many parents allow their children to stay up later during the daylight saving period than is customary in standard time; or it may be due to the fact that children, whose parents wish to maintain the established routine by putting them to bed the same hour daylight as standard, lie awake longer in the daylight saving time period. Due to the extra hour of light parents feel that the children lie awake; and in cities and towns noises from the street, especially of other children playing, are thought to be disturbing factors. In an institution for children, on the other hand, the bed hour is seldom changed, and the number of outside distractions is reduced.

PURPOSE

In order to determine whether the actual sleeping time of young children is decreased during daylight saving time as compared with standard this study was made in an institution. It was felt that in such a situation many variable factors which might be found in a home study would be eliminated and the factor of increased light would be the only change.

Five girls and 8 boys were chosen as subjects. They ranged in age from two to five years. With one exception, all had been in the institution long enough to be accustomed to the routine.

The room in which the subjects slept was long and narrow, about thirty-seven by fifteen feet. The five windows faced east. These had heavy green shades and outside blinds. The beds had five inch cotton mattresses, with ordinary stretch springs, and crib sides. Each child had one heavy woollen blanket, one lighter weight gray double blanket, one extra blanket and one blanket across the bed which was used to keep the other covers in. Each child slept in flannel pajamas or

night gown. The fourteen beds were arranged down the long sides of the room. The amount of light reaching each bed varied but since the children slept in the same places throughout the study, the light factor was constant for each child; it varied only with the weather and with the change to daylight saving time.

METHOD

Twenty-six observations were made in all. Half of these observations were made during standard time and the other half during daylight time. The period of observation began April fourteenth and ended May tenth, 1930. The children were put to bed at 7:00 p.m. and were awakened at 6:00 a.m. The observer went to the institution daily at 6:30 p.m. and at 5:30 a.m. The following data were recorded daily for each child:

1. Time asleep.
2. Time awake or awakened.
3. Louid noises outside and inside the children's room.
4. Disturbing situations such as visits from older children or punishment.
5. Approximate time at which darkness was complete.
6. Arrangement of the window shades.
7. Ventilation of the room.
8. Approximate temperature indoors and out-of-doors.
9. Weather conditions.
10. Changes in number of blankets used.

The children were not allowed to talk while undressing so that the room was quiet the half-hour preceding the bed time. The four children suffering from enuresis were wakened at a definite time each night to be put on bed pans.

In order to eliminate the personal factor of an outsider as much as possible the observer entered the sleep room at 4 minute intervals. The rounds were started four minutes after the day nurse had left the room and were continued thereafter until all the children were asleep. A final visit was made 4 minutes after the last child was asleep. Sometimes, when the observer felt that the children were waiting for her to return, she allowed 8 minutes to elapse between visits.

An Ingersoll watch was used as the timepiece. In order to keep it accurate it was set night and morning by a Naval Observatory-Western-Union Clock.

The criteria used for judging whether a child was asleep were as follows:

1. Eyes closed.
2. Few gross movements.
3. Steady breathing.

If the child appeared to be asleep, the time was recorded. On the next round this record was checked.

RESULTS

Table 1 shows the number of minutes of sleep per night per child and the average for the group of the number of minutes of sleep per night.

Table 2 shows the average number of minutes of sleep for each of four periods. Subject M was not in the institution during the first period of six nights. During the second period of five nights and the third and fourth periods of six nights each, Subject M was present. The first two periods

TABLE 1

Actual number of minutes of sleep per night per child

NIGHTS	SUBJECTS												AVERAGE
	A	B	C	D	E	F	G	H	I	J	K	L	
1	660	666	655	665	664		653	691	657	656	655	652	661.27
2	638	675	638	675	657		637	661	677	673	675	680	662.27
3	640	675	671	674	654		660	652	670	682	676	669	664.90
4	615	650	634	643	655	633	636		666	645	653	649	643.54
5	630	642	620	645	615	646	636		642	645	652	645	638.00
6	645	660	620	633	623	639	639		645	666	661	662	643.90
7	No observations made												
8	637	647	628	658	647	639	635		647	655	643	651	644.27
9	643	655	638	655	647	661	658		645	663	652	661	652.54
10		640				640	630		652	637	641	650	641.00
11	644	663	639	659	665	646	645	626	667	668	661	660	652.75
12	646	656	640	646	653	642	568	639	658	659	657	658	643.50
13	578	595	582	600	597	598	592	597	594	603	596	597	591.58
14	641	649	608	661	653	656	662	650	664	667	677	659	652.16
15		662		666	662	664	644	672	656		651	664	660.11
16	591	652	584	655	606	657	658	650	652	661	637	654	638.08
17	612	661	612	644	637	653	659	652	654	671	650	663	650.54
18	619	663	626	667	660	666	612	651	666	654	626	658	649.90
19	628	660	620	620	612	658	610	629	654	667	659	661	639.83
20	655	659	638	664	652	666	648	672	668	670	652	662	658.83
21	644	658	630	674	675	668	635	668	670	670	667	670	660.75
22	No observations made												
23	646	655	618	659	644	656	610	612	663	664	644	654	643.75
24	635	660	628	648	640	663	642	636	667	645	642	663	647.41
25	637	653	621	656	642	652	615	614	650	660	642	655	641.41
26	636	644	591	640	634	633	591	609	647	653	644	646	630.66

TABLE 2

Average number of minutes of sleep per period

PERIOD	AVERAGE	
1	652.30	Standard time
2	647.18	
3	647.86	Daylight saving time
4	647.13	

TABLE 3

Differences given in minutes or parts of minutes

The difference between the first and third periods is 4.44 minutes
The difference between the second and fourth periods is 0.05 minutes
The difference between the first and fourth periods is 5.17 minutes
The difference between the second and third periods is 0.68 minutes

were at standard time and the last two were at daylight saving time. Since M was not habituated to the routine, records of his sleeping time were omitted.

The difference of 5.12 minutes between the first and second periods shows that any disturbance caused by Subject M was negligible.

CONCLUSION

From the data collected the observer concludes that in a situation where a constant routine is maintained the total night sleeping period of young children is not affected by daylight saving time. Thus it would be possible for parents who find their children are losing sleep on daylight time to make up for the loss by increasing the children's naps during the day or by maintaining the same routine during daylight saving time as during standard time.

MARGARET REESE.